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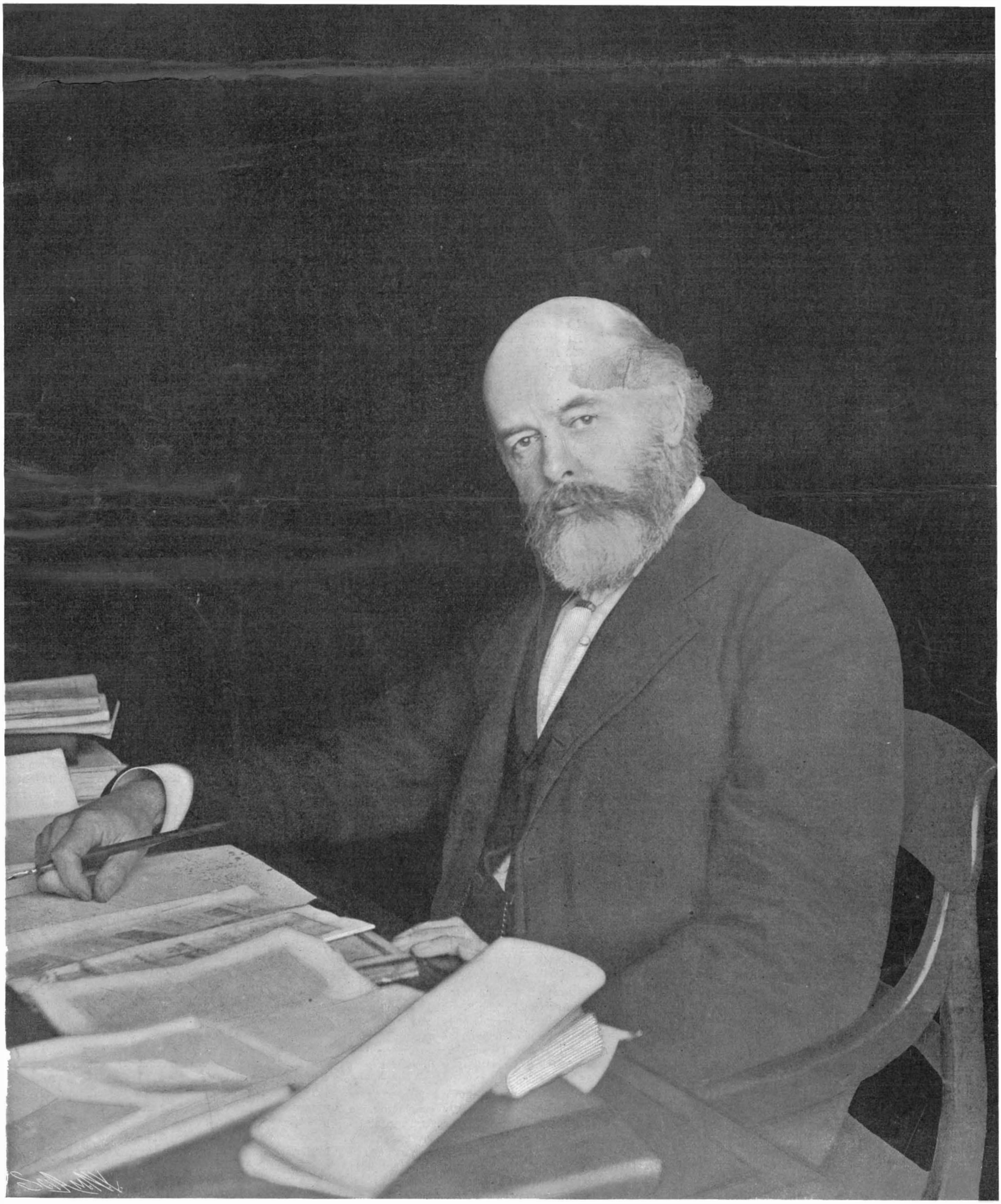

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SIR OLIVER JOSEPH LODGE, F.R.S.—[See page 482.]

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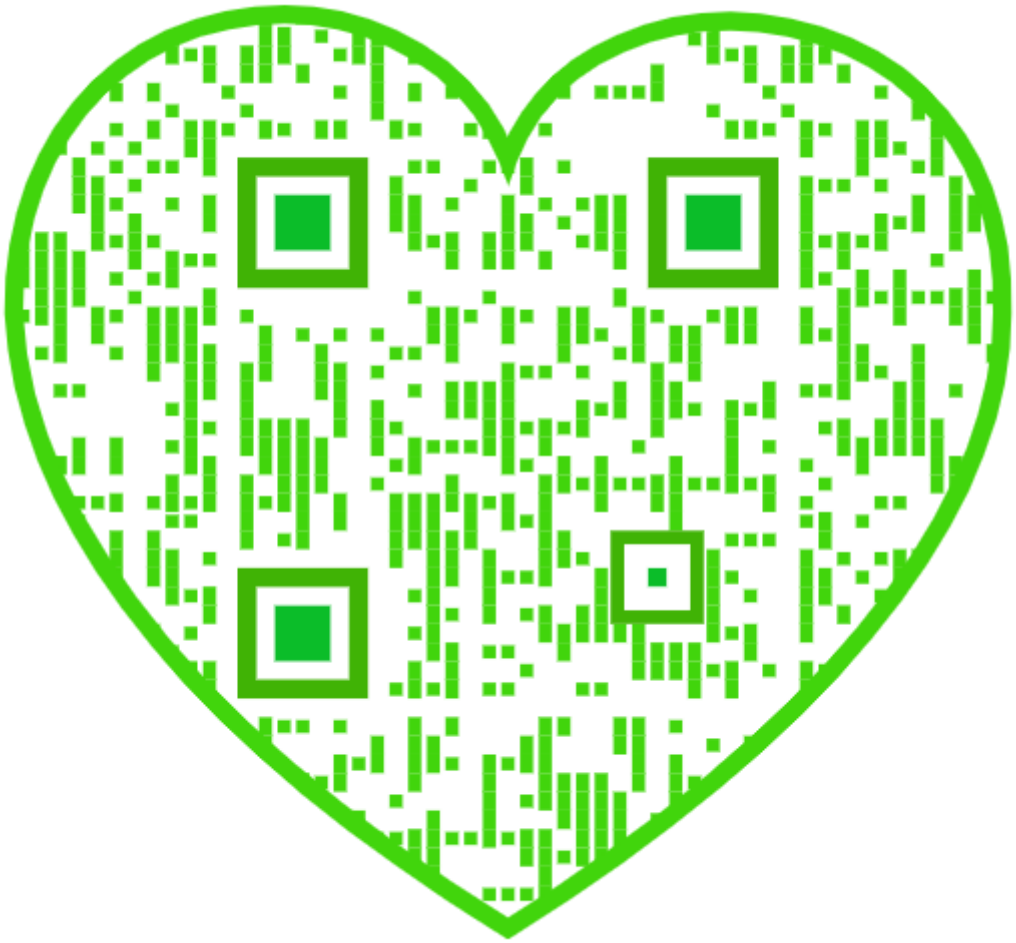

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NEW YORK, SATURDAY, DECEMBER 26, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PROPOSED NEW PATENT OFFICE BUILDING AT WASHINGTON.

It is a notorious fact that the present Patent Office building at Washington is quite inadequate to accommodate the growing business of the Patent Office Department. Not only so, but for a great number of years it has been necessary to find for a large amount of documentary and other material of priceless value temporary, makeshift quarters. The present building is not of fireproof construction, and it needs no multiplication of words to prove that the records of such an important institution as this should be stored where they are entirely protected from damage or absolute loss. Furthermore, the congestion of records is not the only disadvantage under which the lack of accommodation places the department, for one has only to read the annual reports of the Commissioner to be convinced that the work of the general staff has been rendered doubly onerous, and is to a certain extent delayed, by the uncomfortable crowding of the past few years. Year by year an urgent appeal has been made for the amelioration of the present conditions; but for reasons which it is difficult to exactly determine, Congress, while acting with lavish liberality toward some other institutions of far less national importance and merit than this, has so far shown no disposition to move in the matter.

The subject is once more about to be brought to the front by the introduction of a bill which will deal with the proposition in a very comprehensive manner. It is proposed to purchase the large lot of ground lying to the east of the Capitol, and located between East Capitol and B Streets, North, and between First and Second Streets, and erect thereon a monumental fireproof building at a cost of five million dollars, which shall harmonize in architecture with the adjoining Library of Congress, and shall match it in size and dignity. A magnificent square would thereby be provided, with the Capitol on one side and the Library and Patent buildings opposite. The building is to contain suitable offices for the accommodation of the Commissioner of Patents and the working force of the Patent Office, suitable rooms for the storage of records and other documentary matter, and a great "Hall of Inventions," for the display of models and designs of inventions and for their arrangement as far as may be on historical lines, so as to constitute a concrete record of the evolution and development of invention in the United States. The building, as thus erected, will bear to invention the same national relation as the present magnificent Library does to literature. The proposed plan has been submitted to the committee that has in charge the ambitious scheme for the general landscape and architectural beautification of Washington, and has received their unqualified indorsement. Indeed, such a structure would form one of the most important architectural elements in that scheme, and by its erection the United States as a nation would give worthy recognition in their capital city to Invention—a field of human activity in which, perhaps more than in any other, the United States is held, and justly held, to be pre-eminent among the nations of the earth.

Moreover, there is at the present time over five million dollars to the credit of the Patent Office in the Treasury.

BRUNEL AND THE "GREAT EASTERN."

The fascinating interest which will always attach to the "Great Eastern" has been greatly stimulated by a recent paper read by Sir William White, the new President of the British Institution of Civil Engineers. It would be difficult to find an authority better qualified to discuss the technical merits of Brunel's great ship, for Dr. White was the designer of practically the whole of the great British fleet as it floats to-day; many of our own naval designers, including Rear-Admiral Bowles, the late chief constructor of the navy, have studied under him; and no naval architect of the last thirty years has left so profound a mark upon the theory and practice of naval construction. The estimate of the merits of the "Great Eastern" formed a part of an exhaustive review of marine shipbuilding and engineering during the half century or more covered by the professional life of the speaker, and so important was the part played by this famous ship that a great part of the address was devoted exclusively to this subject.

It was at the close of the year 1851 that Brunel began to study the problem of constructing a vessel that could carry sufficient coal for a voyage to Australia and back and provide accommodation for a large number of passengers and a certain amount of cargo. Although he sought advice and assistance in all quarters, it is clear that all the leading features of the design—that is, the structure, propelling machinery, and determination of dimensions—were his own. Dr. White states that he has been familiar with the facts for many years, and that he has recently gone once more, most carefully, through Brunel's notes and reports, with the result that his admiration for the remarkable grasp and foresight displayed has been greatly increased. In fact, Brunel displayed a knowledge of principles such as no other ship designer of his day seems to have possessed, and in proof of this, reference is made to the provision of ample structural strength with a minimum of weight; to the increase of safety by watertight subdivision and cellular double bottoms; to the design of special propelling machinery and boilers with a view to economy of coal and wide radius of action; and to the selection of forms and dimensions likely to minimize resistance and produce a vessel that would be easy in a seaway.

We receive from time to time so many queries as to the exact dimensions of this vessel, that we take this opportunity of repeating the correct figures as taken by Dr. White from Brunel's notebook: The length over all was 693 feet, and between perpendiculars 680 feet; the extreme breadth of hull was 83 feet; the breadth over the paddle boxes, 120 feet, and the depth of the plated hull was 58 feet. The "Great Eastern" could steam at 14 knots an hour and had accommodations for 3,000 people. Compare these figures with those of the most powerful Cunard steamers of that time, which were only 285 feet in length. Nearly half a century elapsed before these dimensions were surpassed by the launch of the "Oceanic," which is 704 feet in length over all. The lines of the hull were drawn by Scott Russell, and they were based upon his well-known wave-line theory. It is evident from Brunel's notes that the estimate for engine power to obtain the desired speed of 14 knots was made by Brunel in conference with Russell. Dr. White makes the significant statement that having carefully looked into the matter in the light of personal knowledge, he is of the opinion that the estimate of power required to drive the "Great Eastern" at 14 knots on an average draft of 25 feet, is practically identical with that which would now be made for the ship if propelled by twin screws—a very remarkable result, when we bear in mind the enormous size of the "Great Eastern" in comparison with any other steamer at the time she was designed.

Furthermore, the structure of the "Great Eastern" was not merely a marvel, but considering the date of her construction it is still, in the judgment of the late chief constructor of the British navy, a most fruitful and suggestive field of study. Brunel was a bridge builder, and he carried the principles of bridge design into his ship. To him a ship had always been a girder from the time when he designed the "Great Western." In the "Great Britain," an iron ship, he introduced new structural arrangements; and that vessel did good work for forty years as a steamer; was then converted into a sailing ship, and finally did duty as a hulk in the Falkland Islands. When he began work on the "Great Eastern" he laid down the principle of construction "that no material shall be employed on any part, except at the place and in the direction and in the proportion in which it is required and can be usefully employed for the strength of the ship, and none merely for the purpose of facilitating the framing and first construction." The "Great Eastern" fully vindicated the structural theories of her designer. She carried enormous loads of submarine cables; passed without structural injury through severe storms; a gaping hole, 10 feet broad and 80 feet long, was torn by the rocks off Montauk Point through her outer skin, yet she reached New York without her passengers being aware of the damage done. In concluding his address, Dr. White sums up with the startling statement that he has most thoroughly investigated the question of the weight absorbed in the structure of the "Great Eastern," and that his conclusion is that it is considerably less than that of steel-built ships of approximately the same dimensions and of the most recent construction. After making full allowance for the greater speed, more powerful engines, and heavy superstructure of large modern passenger ships, it is concluded that the "Great Eastern" was a relatively lighter structure, and this in spite of the fact that at the time she was built only iron plates of very moderate size were available and that the plates used for the outer and inner skin were only three-quarters of an inch in thickness.

SOME EARLY SUBSCRIBERS HEARD FROM.

At the present season of the year, when our old subscribers send in their renewals to the SCIENTIFIC AMERICAN, the Editor receives a large number of letters which contain ever-welcome criticisms of the year's work; suggestions as to the future; and more often than not, a reference to the early acquaintance of the writer with our journal, and the period of years for which he has been a reader or subscriber. Many of the dates mentioned are so remote, so close to the year 1845, in which the first issue appeared, that the Editor decided to request those who considered themselves to be probably among the earliest subscribers, to give him the facts concerning their first connection with the paper. As a result, he has before him what must surely be one of the most unique, and in some respects one of the most pathetic, batch of letters that ever reached an editorial desk. No more convincing evidence of the genuine nature of these replies could be asked than the evidence of age that is shown in the faltering chirography of some. Of those who took the trouble to write, it is found that six have been continuous subscribers for a period of fifty-nine years, or from the very year in which the paper was started, while two others commenced their subscription in 1846, four in 1847, and two in 1849. Fourteen of our correspondents were entered on our lists during the five years from 1850 to 1855, and fifteen more date back to the period 1855-1860. In addition to these enumerated, we have received a host of answers from subscribers who have been taking the SCIENTIFIC AMERICAN continuously for periods of from twenty-five to forty-five years. Limitations of space forbid any extensive quotation from letters which could not fail to be of the greatest interest to our readers; but instead we publish in full a letter which comes to us unsolicited, and which is as welcome as it was unexpected. The Editor should be pardoned for any seeming immodesty in publishing a letter so full of good will and encouragement. The author is a well-known engineer, and was for several years the editor of a high-class technical journal in New York city. He writes as follows:

"After an intimate acquaintance with the SCIENTIFIC AMERICAN for over half a century as man and boy, I must say that, like wine and old friends, it improves with age. It has never made so good an appearance or held such a firm grip upon matters within its field as at the present time. It has a most useful versatility, and covers popular science and practical, everyday engineering without pedantry or 'words of learned length and thundering sound;' so that if a man is compelled to run, metaphorically, to keep up with the improvements of the time, he can read as he goes. If a young man is confined to one paper, for any reason at all, that one should be the SCIENTIFIC AMERICAN. It is a compendium of all that is really valuable in the trades and sciences as they are followed to-day. While I am not without a certain familiarity in the subjects covered by it, I am happy to say that there is not a single issue which I take up, wherein I do not find something which leads me to abandon views formerly held, and subscribe to the better way, the brighter light held by my lifelong friend—the SCIENTIFIC AMERICAN."

A CONVENTION ON MOSQUITO EXTERMINATION.

It seems a novel undertaking to hold a convention for the purpose of discussing the best methods of mosquito extermination and prevention.

But a very large number of persons responded to the call at the first public meeting held on this subject in this city on December 16, 1903, at the Board of Trade rooms on Broadway, corner of Fulton Street.

The meeting was to have been presided over by Hon. Franklin Murphy, Governor of New Jersey, but he was unable to attend. Hon. Robert W. De Forest, one of the vice-presidents, presided instead. The meeting was called to order by Mr. Henry Clay Weeks, who explained the object of the convention and its purposes. He was elected secretary and Mr. William J. Matheson was chosen treasurer. A permanent national organization was provided for, for the promotion of the object.

There was much interest manifested, and several papers were read on the different phases of the mosquito problem.

Among the papers were: "The World-wide Crusade," by Dr. L. O. Howard, of the Agricultural Department at Washington, D. C.; "The Sphere of Health Departments," Ernst J. Lederle, Ph.D., president of the Department of Health, city of New York; "The Work of the United States Public Health and Marine Hospital Service," Passed Assistant Surgeon J. P. Perry; The Determination of Marsh Soil Surveys," Prof. Milton.

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Whitney, Chief, Division of Soils, Washington, D. C.; "What Railroads Can Do," William H. Baldwin, Jr., Esq., president L. I. R.R. Co. (Penn. R.R. Co.); "The Aesthetic Side of the Question," John Claflin, Esq., president H. B. Claflin Company, president Morristown, N. J., Improvement Society; "The Exactness of Proofs of Transmission of Malaria," William N. Berkeley, M.D., author of works on mosquitoes, New York; "How a State Appropriation May be Used," Dr. John B. Smith, New Jersey State Entomologist; "What a Rural Community Can Do," Walter C. Kerr, Esq., president Westinghouse, Church, Kerr & Co., Staten Island; "What the General Government Should Do," Frederick C. Beach, Esq., of the SCIENTIFIC AMERICAN; "What New York State Ought to Do," Dr. E. Porter Felt, State Entomologist, Albany, N. Y.; "How Far Does Extermination Exterminate," William J. Matheson, Esq., North Shore, L. I.; "The Long Distance Theory," Spencer Miller, Esq., Engineer, South Orange, N. J., Improvement Society; "Mosquito Engineering," Henry Clay Weeks, Engineer, Bayside, city of New York.

Major Georgas, of the United States Army, addressed the convention on the work that had been done in and about the city of Havana, Cuba, which had been helpful in abating the former conditions.

Dr. Howard sent a letter describing the mosquito plague in the colonies of Great Britain. Germany and Japan were also taking measures to fight the insects.

John Claflin, who was to speak on "The Aesthetic Side," described the malarial breeding places. He stated that the Anopheles, unlike the Culex, breed only in sunlight. Concerning the drainage of a malarial swamp, he said the malaria had apparently been introduced there by Italian laborers. The Anopheles had become infected, and, in turn, transmitted malaria to the residents.

Among the vice-presidents named were: Mr. William C. Whitney; Prof. Nathaniel S. Shaler, Harvard University; Mr. Louis C. Tiffany; Mr. Otto H. Kuhn, Kuhn, Loeb & Co.; Mr. G. Waldo Smith, president of United Civic Societies of Queens Borough; Mr. Colgate Hoyt, Mr. Harvey Murdock, president North Shore, L. I., Improvement Association; Prof. Franklin W. Hooper, director Brooklyn Institute of Arts and Sciences; Prof. Charles B. Davenport, University of Chicago; Prof. L. H. Bailey, Cornell University; Mr. L. C. Weir, president Adams Express Company; Mr. A. J. Cassatt, president Pennsylvania Railroad; United States Senator John Kean, of New Jersey.

The meeting adopted resolutions recommending the appointment of a provisional committee to consider the formation of a central organization of a national character, with which local bodies might co-operate in conducting a general national crusade against the mosquito.

AN ENGLISH TEST OF THE EDISON BATTERY.

Mr. W. Hibbert read a paper on the Edison accumulator before the Institution of Electrical Engineers recently. Since the first announcement of Mr. Edison's invention nearly three years ago, very little of an authoritative nature has been published about the cell; the paper which Dr. Kennelly read in May, 1901, showed that the invention was full of promise, and further results of more extensive experiments and of practical trials have since been awaited with eagerness. A description of the cell itself was published in the SCIENTIFIC AMERICAN and SUPPLEMENT, and as it has undergone little alteration since then we need not describe it in detail here. The active materials, it will be remembered are nickel oxide and iron, and the electrolyte is a 20 per cent solution of caustic potash. The chemical changes on charge and discharge may be represented by the equation

$$\underset{\text{After charge}}{NiO_2 \mid KHOaq \mid Fe} \rightleftarrows \underset{\text{After discharge}}{NiO \mid KHO.aq \mid FeO},$$

the electrolyte serving merely as an oxygen carrier, and not taking any actual part in the final changes of the active material, as does the sulphuric acid in the lead-lead-peroxide cell. The active materials are packed in perforated steel pockets, and the plates, though thin, are rigid and light. The construction is thoroughly mechanical throughout, and the lightness is obtained without any sacrifice of durability, which is one of the chief faults of the lighter types of lead cells. The standard size of automobile cell is 13 inches high (over all) and 5.1 x 3.5 inches horizontally. The weight is 17.8 pounds. The E. M. F. is approximately 1.35 volts, and the internal resistance 0.0013 ohm; the output at 60 amperes discharge is 210 watt-hours, the capacity working out, therefore, at 11.8 watt-hours per pound. This figure agrees very closely with those which were published originally. Dr. Kennelly put the output at about 14 watt-hours per pound. In an article in Nature it was very carefully calculated from a discharge curve which had been published that the output was 10 watt-hours per pound. The lightest lead cells in some instances approach, or even exceed, these figures, but on the average the result is considerably better than that obtainable in practice with lead accumulators. It will be seen, however, that in many other respects the Edison cell promises to prove much superior, especially for motor-car work.

Mr. Hibbert's tests were made partly under laboratory conditions and partly on the road. Discharge curves taken in the laboratory show that the Edison cell possesses in a remarkable degree one very desirable characteristic, namely, that of giving a good output in ampere hours when discharged at heavy discharge rates. Taking the normal discharge current as 30 or 40 amperes, the curves show that more than 80 per cent of the normal ampere-hours can be obtained when discharging at so high a current even as 200 amperes. A lead cell under similar conditions would probably not give more than 50 per cent of its normal output. Experiments on the road showed that this result could be obtained under practical conditions. A 32-mile run was made from Leicester to Northampton against a head wind all the way; on the level the current varied from 55 to 60 amperes, as against the usual 40; uphill it was from 90 to 100 amperes, and on one occasion rose above 150 amperes. The total discharge came out as 190 ampere-hours, the normal standing discharge being 160 ampere-hours. The battery had been fully charged before the start, 242 ampere-hours having been put in in 1 hour and 20 minutes. This particular case shows that there is an extra discharge—30 ampere-hours in this instance—which can be got from the cell; it is due to the fact that the voltage at the end of the discharge does not continue to drop rapidly, but, when it has fallen to about half a volt, becomes steady again for another hour. There is, in consequence, a reserve capacity which, though not generally used, may prove very valuable in emergencies such as the above.

Some other results obtained by Mr. Hibbert may be quoted. A cell after being short circuited for 48 hours, recovered its original capacity after two charges, and was apparently none the worse for this severe treatment. Experiments on the rate of charging were tried, and showed that high charging currents can be safely used. A fully discharged cell was recharged for an hour at 177 amperes; 124 ampere-hours, or 70 per cent of the charge, were obtained on discharge at 60 amperes. Experiments on the road confirmed this result, 70 per cent of the charge being obtained after charging at 200 amperes. The efficiency of the cell is not quite so good as that of a lead cell; the following figures were obtained under different conditions: at 30 amperes charge and discharge 66 per cent, at 60 amperes 60 per cent, at 100 amperes charge and 60 amperes discharge 56 per cent, and at 177 amperes charge and 60 amperes discharge about 50 per cent. On the other hand, the cell endures a period of rest before discharge well, and also does not suffer if allowed to stand discharged for some time. If discharged immediately after charge a somewhat large discharge is obtained, but after two days' rest a discharge of 155 ampere hours is given; a further twenty-four days' rest only had the effect of diminishing the discharge to 125 ampere hours, or 80 per cent of the discharge after the two days' rest.

The trials on the road were made in a runabout with a battery of 38 cells, weighing about 700 pounds; the total weight, with two persons, was about 2,000 pounds. The trials were planned to afford answers to the following questions:

(1) Is the capacity the same on the road as in the laboratory?

(2) Will the battery stand excessive discharges on the road?

(3) Will it take a rapid charge and utilize it on the road?

(4) Will it recover after lying discharged for some time?

(5) Does the capacity fall off by reason of the shaking?

(6) What attention is required?

The experiments which we have already quoted show that the answer to the first four questions is in the affirmative. With regard to the fifth question, the results were very satisfactory. The car had run 400 miles before Mr. Hibbert took it over; its capacity was then 159 ampere-hours on standing discharge. Mr. Hibbert ran it in all 500 miles in the course of a month, and at the end of that time the capacity on standing discharge was 158 ampere-hours, showing, therefore, no appreciable deterioration. As regards attention, Mr. Hibbert found very little to be required; none of the terminals worked loose or showed signs of getting unduly warm with the heavy charging currents sometimes used. The only matter that had to be attended to was the replenishing with distilled water which was required after every five or six charges.

The general results of Mr. Hibbert's tests are most encouraging; the only point on which further information is required is durability, but all the evidence is in favor of this proving satisfactory. It certainly seems as if the hopes aroused by Dr. Kennelly's paper are within measurable distance of realization.

FINAL WORLD'S FAIR DIVIDEND.

The World's Columbian Exposition of 1893 does not seem to have proved such an abject financial failure after all. At the last meeting of the Board of Directors a final dividend of 4.65 per cent on the capital stock was declared.

The dividend is equal to 46½ cents per share, and is payable on March 1, 1904. The transfer books of the stock company close on January 2, 1904.

The dividend will be paid by check to stockholders of record on the secretary's book. The circular to the stockholders states that a small surplus will remain after paying this dividend, but that it will be so small that it will not pay to divide it. It is being retained to cover cost of possible litigation.

All the stockholders are asked to relinquish their claims upon the surplus, so that it may be donated for some public object by the board of directors. The stock is widely distributed. Many of the certificates are framed and hung on the walls of the owners' homes.

The shareholders were paid a dividend of $1 per share soon after the exposition closed. With this coming distribution the return from an investment of $10, the cost of each share, will be $2.46.

TO OUR SUBSCRIBERS.

This is the last issue of the year—the fifty-eighth of the SCIENTIFIC AMERICAN'S life. Since the subscription of many a subscriber expires with the present number, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the next issue. To those who are not familiar with the SUPPLEMENT a word may not be out of place. The SUPPLEMENT contains articles too long for insertion in the SCIENTIFIC AMERICAN, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the SCIENTIFIC AMERICAN and SUPPLEMENT the subscriber receives the benefit of a reduction in the subscription price.

THE CURRENT SUPPLEMENT.

The current SUPPLEMENT, No. 1460, opens with an article by the London correspondent of the SCIENTIFIC AMERICAN on the highest tunnel in Europe, a tunnel which is to be found on the line of the Albula-Engadin Railway, Switzerland. Prof. Berthelot presents an interesting summary of the relation between the intensity of the voltaic current and the manifestation of the electrolytic output. An exhaustive description of the Lake submarine boat will be found in the SUPPLEMENT, an elaboration of the article elsewhere published in the present issue of the SCIENTIFIC AMERICAN. Recent excavations at Gigthis are described and illustrated. The Wilde lecture on the Atomic Theory is concluded. An excellent description of the Renard dynamometric fan for measuring the power of gasoline motors will doubtless interest chauffeurs. Emile Guarini presents an account of the single-phase traction experiments conducted by the Union Electrical Company, of Berlin.

EIFFEL TOWER TO BE DISMANTLED.

An engineering feat of no small importance will be the razing of the Eiffel Tower in Paris, for this renowned structure is doomed to disappear from the Champ de Mars. The concession for the building of the tower will expire in 1910, and probably nothing would be done in the immediate future if it were not for the fact that, like the famous Tower of Pisa, it is beginning to lean to one side. In the case of the Tower of Pisa, the center of gravity is not far displaced, since the tower was purposely built in that position. But with the Eiffel Tower the case is different, since it was designed to stand erect, and any great amount of declination will displace the center of gravity to a point dangerously near the outside of the base.

DISTRIBUTION OF THE NOBEL PRIZES.

The Nobel peace prize has been awarded to the Hon. W. R. Cremer, M. P., publisher of the Arbitrator, of London, for his work in behalf of international arbitration.

A new telegraph cable connecting Great Britain with Australia via Cape Colony is being constructed. Already the first section to the Cape has been laid. The next section will be carried across the Indian Ocean to Mauritius, thence to the Keeling Islands, and from there to Perth, in Western Australia. When this new line is completed there will be three distinct cable routes to Australia from Great Britain via India, the recently laid Pacific cable, and this new one via the Cape, respectively, thus affording adequate alternative routes should any one or two be interrupted or cut by any agency.

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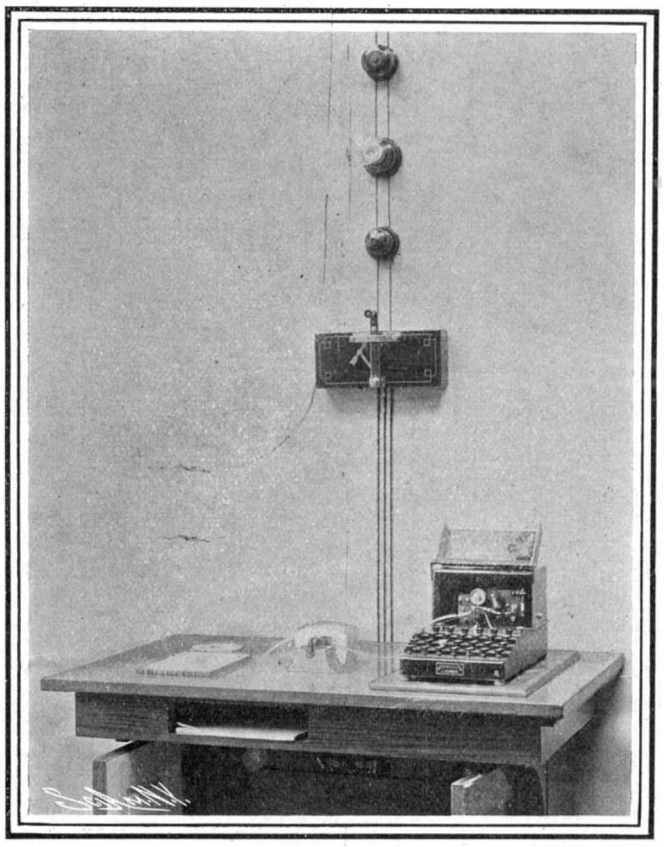
THE BERLIN PRINTING-TELEGRAPH CENTRAL STATION.

BY DR. ALFRED GRADENWITZ.

On October 1 a most valuable addition to the Berlin telephone service, with nearly 68,000 subscribers, was made when the "Ferndrucker-Centrale" a type-printing telegraph service, was opened to public service.

This printing telegraph as constructed by the Siemens & Halske Co. is similar to the well-known Hughes type printer and the Baudot telegraph. Its distinctive feature is its simplicity. The telegraphing of a letter, figure, or punctuation mark is effected simply by pressing down a key corresponding to the signal in question. The manipulation of the new telegraph may be learned by anybody in a short time. The apparatus is nothing else than a *tele-typewriter.* The keyboard of the printing telegraph is similar to that of an ordinary typewriter, comprising four banks of seven keys each, of which 26 are provided each with a letter on one side and a figure or sign of punctuation on the other. Of the remaining two keys, one serves as a capital key or as a letter shift key, whereas the other, bearing the inscription "figure," serves as a figure or punctuation shift key. By striking either of these keys, the type wheel of the printing telegraph is displaced either for letters or figures in a manner similar to the Hughes apparatus. The apparatus at each end of a line may be used either as transmitter or receiver without any change, both being automatically and simultaneously operated as soon as the first white key, being the blank key, is struck. The apparatus will then become a transmitter.

The typewheel, as shown in the illustrations, is formed with a circle of letters and with a circle of figures and punctuation marks. On actuating the shift-key the typewheel is displaced automatically on its shaft, so as to bring the circular rows of signs mentioned, above the printing surface of the paper ribbon. By actuating an ordinary key on the other hand, the typewheel is rotated far enough to bring the desired type in front of the paper. The latter will be then pressed against the wheel and impressed with the character, return downward instantly, and be moved as far as the interval of two letters ready to receive the next sign. This process will occur simultaneously in both of the machines at the terminal stations, and is automatic in the receiver, no matter whether it is or is not attended by an operator. If the owner of the apparatus be absent, the telegram may be read on the paper ribbon on his return. The electric printing telegraph will thus give two perfect records of the same telegram, one on the sending and the other on the receiving apparatus, the transmitter having always at his disposal an evidence of the correctness of his communication so as to exclude the possibility of mistake. The typewheel is inked by an inking wheel to the right.



TWO GROUP SWITCHES.

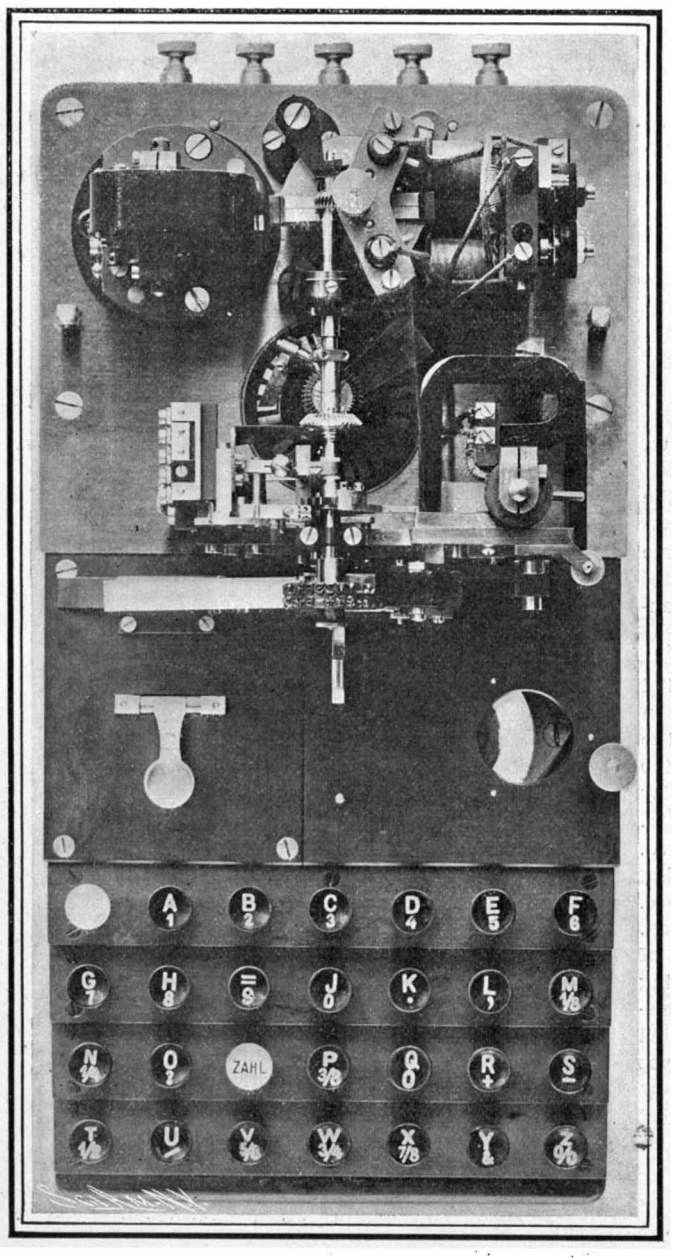
As soon as the capital or initial key is pressed downward, the circuit of the transmitting apparatus is completed. A switching roller is set rotating, which sends electric currents of alternating directions into the printing telegram circuit and through the line relays connected with the apparatus. Both the transmitting and receiving apparatus will be energized by local currents, which through the medium of relay magnets, cause the rotation of the type wheel from the initial position through the same distance in all stations. When a letter-key is depressed a peg attached to one end of its lever will strike against the rotating switching inking roller, stopping the latter, and thus the typewheel of the printing telegraph. At the same time the type-levers of both apparatus being attracted, the corresponding letter will be printed. As long as the key is pressed downward, the typewheels cannot move, thus enabling the transmission to take place at any desired speed. After a telegram is transmitted, both the transmitter and receiver will be cut out automatically with a certain position of the type wheel, the apparatus thus being stopped.

Twelve accumulator cells inclosed in a box, serve as a working battery. The battery is divided in the middle so that either half of the battery only is used in the local or line-current circuit. The tension (12 volts) in the line circuit is so low as to exclude any possibility of an inductive influence of printing telegraph circuits on neighboring telephone circuits. It is thus possible to include both kinds of conductors in the same cable. A small electrometer, driven by the accumulator battery, will at the same time wind up the spring of the apparatus.

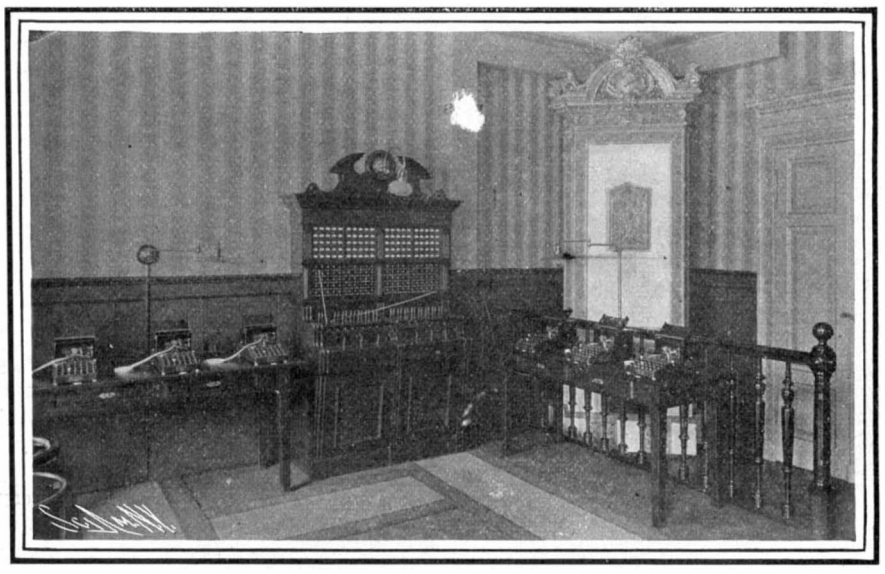
A central station, similar as to its arrangement and working to telephone central stations, has been opened at 28 Zimmerstrasse, Berlin, for subscribers. This central station is fitted with a switchboard with indicators (the white shields shown in the upper compartment) and catches (in the compartment below the indicators) for 100 subscribers. Sixteen connecting lines permit the simultaneous connection of thirty-two subscribers so as to enable a simultaneous communication between one-third of all the subscribers when the switchboard is completed. As soon as a subscriber presses down the calling key of his printing telegraph, the annunciator of the indicator-board will drop and an alarm be rung. The official in charge will put himself in communication with the caller in order to ascertain the desired connection through an inquiring apparatus, six of which are reserved for this purpose, and connect both subscribers, so that their apparatus are ready for direct communication. This shows the similarity of service with telephone service. There is, however, in addition, the possibility of connecting any desired number of subscribers to the same printing telegraph, so as to transmit the same communication simultaneously to all the subscribers.

Similar telegraphic services from one central station to a certain number of subscribers simultaneously by "ticker," have for some time been worked in New York, London, and Paris. A similar service has been carried out also in Bremerhaven, Germany, for transmitting ship telegrams from one central station to 100 subscribers in different places. The central station just opened in Berlin is used in addition to the mutual communication between the subscribers, intended to transmit similar information to a certain number of subscribers, limiting the service at first to Exchange telegrams, which are transmitted at given hours from the transmitting apparatus in the Berlin Exchange. The same system of communication could be employed for transmitting telegrams from a central telegraph office to a certain number of newspaper offices.

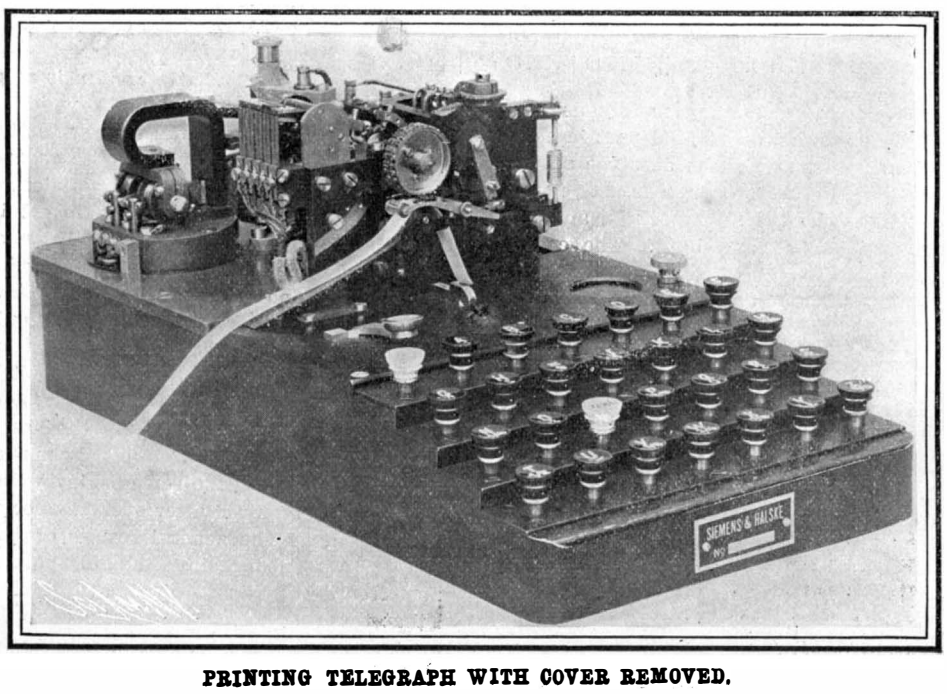
The city of Valladolid is about to lay down a system of general collectors and surface drainage.



TOP PLAN VIEW OF PRINTING TELEGRAPH.



PRINTING-TELEGRAPH CENTRAL STATION.



PRINTING TELEGRAPH WITH COVER REMOVED.

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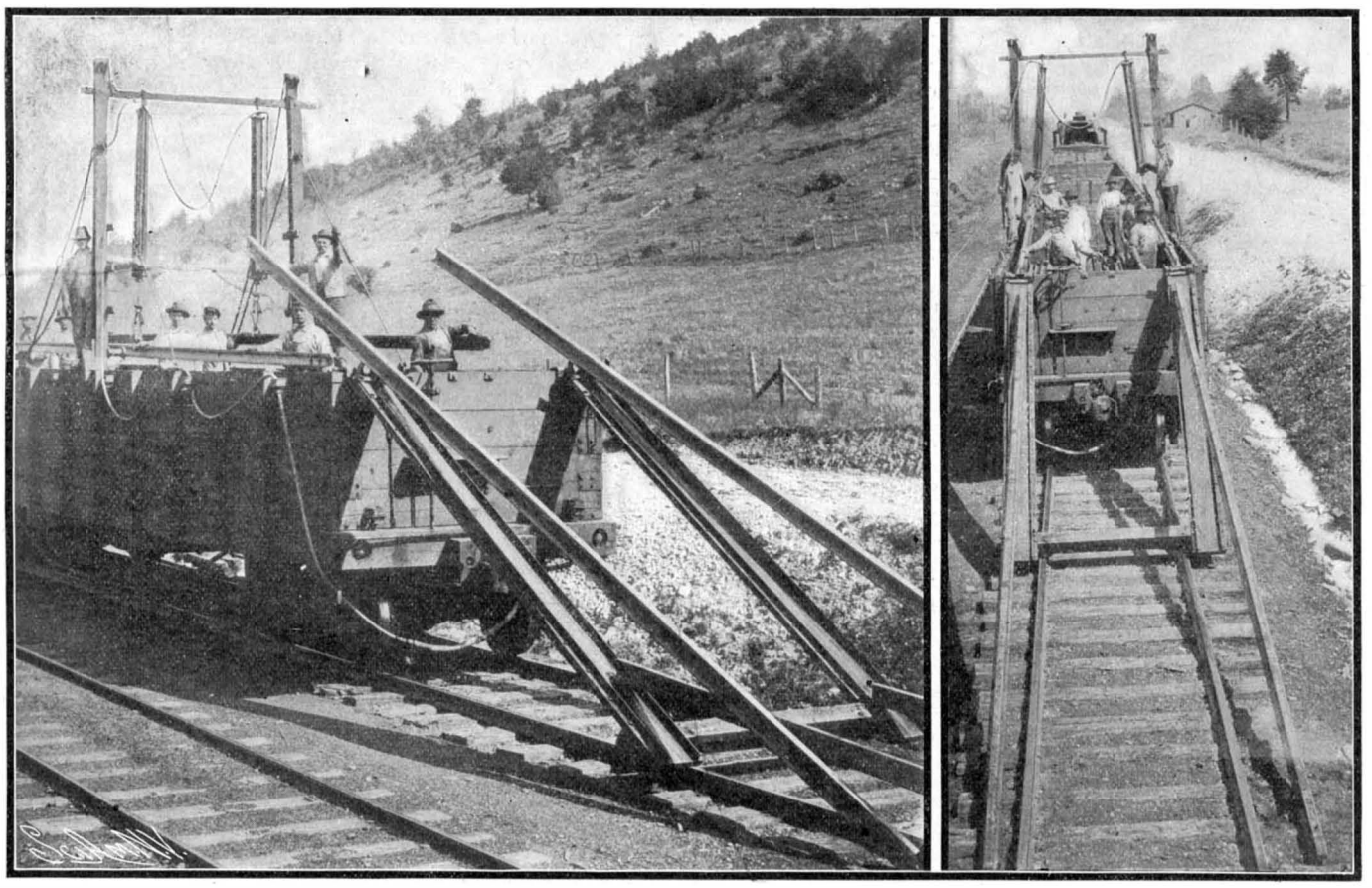
A PNEUMATIC RAIL UNLOADER.

It is the usual practice of rolling mills to ship rails in cars having sides and end-boards which are generally permanently secured. Indeed, much rail is shipped in deep, steel cars, so that it is impossible to remove the sides or ends for convenient unloading. For the purpose of meeting these conditions, Mr. Henry Ware, roadmaster of the Buffalo, Rochester and Pittsburg Railway, has especially designed a pneumatic rail-unloader which will undoubtedly be of interest.



UNLOADING RAILS FROM A CAR WITH PNEUMATIC APPARATUS.

The cars shown in the photographs are provided with permanent sides and end-boards, the inside measurement of which is four feet five inches high. From such cars it is not an easy matter to unload and distribute the heavy sections of rail now commonly used, even if it were possible to drop them over the sides of the car by hand—a bad practice which often results in serious damage to the rails. On the sides of the car a removable gallows frame is mounted, the uprights of which are secured directly to the sides by adjustable stake-pockets straddling the sides of the car, and by two adjustable brace-rods. The bottom of the uprights is so formed that they rest sufficiently on the top of the car to relieve all vertical strains on the pockets. By means of a vertical wedge the pocket is adjusted to fit any width or kind of car.

The longitudinal brace-rods are connected at the top by a hand bar from which two air-hoist-cylinders are hung. A skid-frame is hung from the end of the car, the two channel-shaped skids of which frame are connected at their lower ends by a cross-beam resting in lugs riveted to the skids. Each end of this cross-beam carries a small flanged wheel, which runs upon the track-rail. The head of each skid is provided with a roller in alinement with another roller on the inner side of the upright of the gallows frame. The piston rods of the hoists are equipped with rail tongs.

In operating this device four men are required to each cylinder, making eight men to unload two rails at the same time. One man is stationed at the cylinder, one at the tongs, and one at each end of the rail. When the rail is lifted to a sufficient height, the men guide it so that it will rest on the roller attached to the inside of the upright and on the roller on the head of the inclined skid attached to the end of the car. When the air is released and the tongs detached, the men start the rail on the roller toward the skid. The center of the rail having passed over the roller at the head of the incline, the rail tips up and slides to the ground. As the train moves on, the upper end of the rail gradually reaches the ground without any possible danger or damage. The men are not required to do any part of the lifting, that being effected entirely by pneumatic power, which is taken from the train air-brake line and is transmitted to the suspended cylinders through flexible hose.

This apparatus has been in use but a short time; still, it has fully demonstrated its practicability and usefulness. A great saving in the cost of handling the rails is effected; and the laborious work of unloading by hand is entirely avoided. With the present system of unloading rails by hand, from twenty to twenty-five men are needed to lift one rail out of the car. With this device only eight men are required to unload two rails at a time; and this is done in less than a quarter of the time ordinarily consumed in unloading one. Appliances in the form of steam and pneumatic carriages have been employed; but their use is attended with the objection that when one car is unloaded, the train is obliged to return to the siding, where a shift of cars must be made in order to bring the derrick next to the car to be unloaded. With Mr. Ware's apparatus, each car unloaded can be cut off from the train and allowed to stand on the track until driven to a siding by regular traffic.

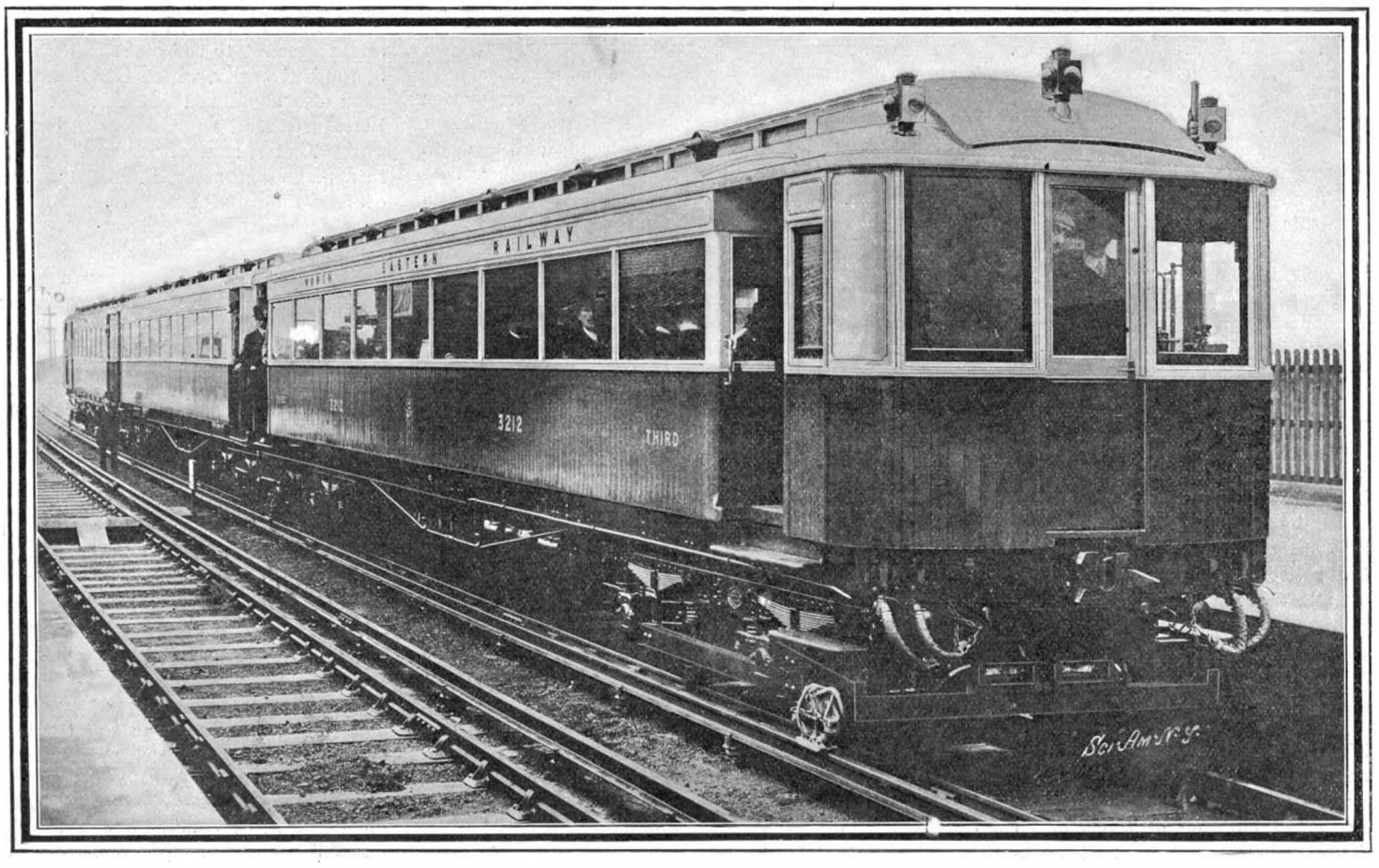
THE FIRST BRITISH STEAM RAILWAY TO ADOPT ELECTRICAL WORKING.

BY OUR LONDON CORRESPONDENT.

The forthcoming inauguration of the electrical working of the North-Eastern Railway is a very important event in British railway enterprise, because it is the first instance of one of the great railway companies replacing steam by electric traction. It is true that on the Mersey Railway electric trains have displaced the old steam-hauled trains, but this is only a very short line. The North-Eastern Railway is the first to grapple on a really large scale with the problem presented by the steady increase in working expenses and tramway competition. Another point of great interest in this scheme is the fact that Parsons steam turbines will be used exclusively in the new power house at Carville, to drive three-phase alternations, generating at 5,500 volts.

The engineering conditions to be met present features differing essentially from those prevailing in the electrification of a London tube railway, because some 37 miles of single, double, and four-line track are involved, and there are numerous junctions, crossovers, and other special track work. There is also a very heavy goods traffic to be provided for, which, except on the Quayside branch, will continue, at any rate for the present, to be dealt with by steam locomotives.

After careful examination of the advantages and cost of various systems it has been decided to operate the trains by continuous current obtained from a single collector rail placed in the six-foot way with a return circuit through the running rails. The current will be derived from rotary converters and static transformers which convert three-phase current at a pressure of 5,500 volts and periodicity of 40 into continuous current at a pressure of 600 volts. The collector rail will be of special high-conductivity steel, Vignoles section, 80 pounds per yard, carried on insulators composed of reconstructed granite placed outside the running rail and distant 3 feet 11½ inches from the center of the track. On double track the separate collector rails belonging to each track will be normally placed between the two tracks, but at junctions, crossings, etc., or wherever there is any obstruction in the six-foot way it can be transferred to



Forty miles of this steam road are now operated on the third-rail system.

INAUGURATION OF ELECTRIC TRACTION ON THE NORTH-EASTERN RAILWAY, ENGLAND.

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the outside of the track as required. At level crossings, stations, etc., the collector rail will be protected by two creosoted boards bolted against distance pieces on each side of the rails. Under normal conditions the collector rails will have no protection, but holes for fixing this are being punched in all the collector rails, so that protecting boards may be readily applied at any place found desirable. Instead of adopting a second collector rail in the center of the track for the return current, as has been done in some cases, it was found that the Board of Trade requirements could be more economically met by bonding the running rails, but the position of the single collector rail has been so fixed that a return collector rail can be installed between the rails at any future time should this prove desirable in the event of great extension of the traffic on these lines.

ELECTRIC POWER SUPPLY.

Current will be supplied to the collector rail from five substations located at Pandon Dene, Wallsend, Cullercoats, Benton and Kenton. Fourteen 800-kilowatt rotary converters will be installed, distributed among the various substations so as to best meet the load. The substation containing the largest plant capacity will be Pandon Dene, where four of these rotaries will be installed. In order to meet the excessive fluctuations of the load each rotary has been specially designed to operate without serious sparking at an overload of 100 per cent for ten minutes and at an overload of 200 per cent momentarily. The main static transformers are of the single-phase, oil-insulated, self-cooling type. To each rotary converter is coupled a small induction motor fed by a special transformer, and the rotary converter is started up by means of the induction motor until it attains the synchronous speed of the rotary, when it is switched into the high tension busbars in the usual way. The substations will receive their supply of energy at a pressure of 5,500 volts, three-phase, through three-core, paper-insulated, lead-covered cables laid solid in wooden troughs along the railways.

The new rolling stock will comprise motor and trailer coaches, and will be of the open-corridor type, lighted and heated by electricity. Each motor coach will be equipped with two G. E. 66 motors, each rated at 150 horse power, both motors being carried on one bogie truck. The unit train will be composed of two motor coaches with one trailer coach between them, this being strengthened when necessary by the addition of another unit train. The motor coaches will have drivers' compartments at one end only, but a master controller will be fitted in the vestibule at the other end also, so that the coach may be driven from this end if necessary.

The ordinary accommodation train will take about 23 minutes for the journey from Newcastle to Tynemouth, the average speed being about 22 miles per hour, including stops. Express trains will reduce this time to 15 minutes.

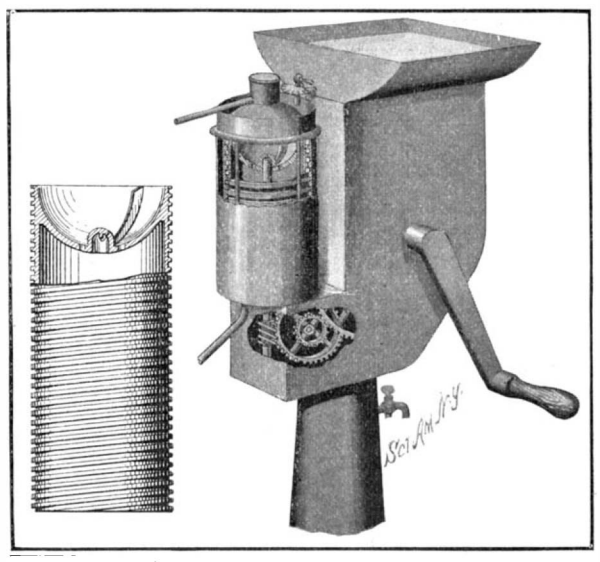
The Quayside branch line, which is used for freight only, is also being equipped for electrical operation, the object being to overcome the ventilation difficulties which now prevent the line from being fully utilized owing to its being for the most part in tunnels and on a heavy gradient. There will be two electric locomotives for the Quayside branch, and these will be equipped in the same way as the motor coaches with multiple unit controller, Westinghouse air brakes, etc. Each locomotive will be capable of starting with and hauling a train weighing 150 tons up a gradient of 1 in 27 at a speed from 9 to 10 miles per hour.

Instead of constructing a generating station of their own the railway company will purchase their current from the Newcastle-on-Tyne Electric Supply Company, Limited. A portion of this current will be generated at the existing Neptune Bank station at Wallsend, but this station is now nearly loaded up and the supply company have in course of erection a larger station situated at Carville, about half a mile further down the river, and it is from this new generating station that the bulk of the supply to the railway company will eventually be obtained. The designs for this new station are now completed and the contracts let. The generating plant is to consist of steam turbo generators, each of 3,500 kilowatts, with an overload capacity of 5,000 kilowatts for two hours, and the order for these has been obtained by Messrs. C. A. Parsons & Co. As the space occupied by such a set compared with that taken up by the boilers necessary to supply it with steam is so small, the usual arrangement of placing the boiler house parallel with the engine room has been abandoned, and instead each turbine unit will have a separate range of boilers running at right angles to the engine room. Every two ranges of boilers will be combined in one centrally-fired boiler house and will be provided with independent flues, economizers, induced-draft fans, and a short iron chimney.

Texas's unique star-shaped building at the World's Fair is receiving its staff ornamentation. Its peculiar shape and its great dome render it conspicuous among the State structures.

IMPROVED CREAM SEPARATOR.

An improved cream separator of the centrifugal type forms the subject of a patent recently granted to Mr. Henry H. Stüssy, of Beresford, So. Dak., Box 154. The invention embodies some novel ideas, which are very ingenious and interesting. The separator proper has been broken away in our illustration, to show the interior details, which comprise a stationary cylinder within which an inner cylinder is mounted to rotate. The stationary cylinder is formed with a dome-shaped top, opening into a small receptacle for the cream, which is tapped out into an outer chamber, and thence led off to any desired receptacle through the outlet pipe shown. The top of the rotary cylinder is closed by a bowl-shaped receptacle. On the outer surface of this cylinder a spiral groove is cut. Similarly, but in reverse direction, a groove is cut on the inner surface of the stationary cylinder. Milk is fed from a tank at the right into a trough above the separator cylinders, whence it is led through pipes to the space between the two cylinders near the bottom. The inner cylinder is rotated by a crank through a train of step-up gearing, which gives it a very rapid motion. The effect of this rapid rotation is to drive the cream by centrifugal action up the outer or stationary groove to the cream receptacle at the top, while the skimmed milk moves up the groove on the rotating cylinder and falls into the bowl-shaped receptacle. Two or more radial flanges in the bowl keep the liquid in motion, and assist in forcing the cream up the dome. The skimmed milk passes out of the bowl through small perforations therein, and is tapped out through a pipe at the bottom of the separator. The driving mechanism is inclosed in a box, the lower part of which serves as a reservoir for oil. Into this one of the wheels dips, and distributes the lubricant to the rest of the driving mechanism. The operating crank is connected with the train of gearing through a clutch consisting of a ratchet wheel



IMPROVED CREAM SEPARATOR.

and pawl, so that upon stopping the rotation of the crank, the separator may continue to operate under its own momentum.

The Radium Industry.

Notwithstanding the difficulty in its production (many tons of ore being required to produce 1 gramme), a radium industry has already developed in Germany and France, and although 1 gramme is sold at a little less than $2,000, the manufacturers are said to have orders for several hundred grammes.

The demand for medical purposes exceeds the supply. Radium possesses all the important qualities of the Roentgen rays in addition to the invaluable property of being ready for use at any time and furnishing its rays without the employment of apparatus. It has been demonstrated that a small glass tube, not larger than a goose quill, containing a little more than a thousandth part of a gramme, is as effective as an expensive and complicated electric apparatus for the treatment of cancer—surpassing the best effects of the Roentgen rays.

Automobile Notes.

In accordance with a suggestion from the Automobile Club of America, representatives of all the foreign automobile clubs, in a meeting at Paris, decided in favor of an amendment to rule 9, which will make it possible for drivers other than club members to run machines in the Gordon Bennett cup race of 1904. As a result, it is probable that Barney Oldfield and one or two other American chauffeurs who have made records in this country will pilot our cars, we hope, to victory on the course that has already been selected in Germany in the vicinity of Homburg. The race will probably be run some time between July 5 and 15, 1904.

The Paris automobile show opened with great *éclat* on December 10. It will last till the 23d, and will be followed next month by the New York show, which will last from the 16th till the 25th of January. One of the features of the French show is said to have been a 40-horsepower automobile train in which the power is supplied to all four wheels of each car. The train is said to have run from Paris to Versailles successfully. Another feature of the show was the Martini car in which Capt. Deasy made the ascent of the Rochers de Naye (as detailed in the current SUPPLEMENT) last October. Not only the car, but portions of the cogwheel railway on which the ascent was made, were exhibited. The great increase in electric vehicles was one of the most noticeable things with regard to the show.

SIR OLIVER JOSEPH LODGE, F.R.S.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

"A fine scientist with that rarest of gifts, a power of exposition commensurate with his great learning, and absolutely the kindest man to students who ever sat in an English chair of physics," is the graphic estimate of Sir Oliver Joseph Lodge, F.R.S., by one of his subsidiary co-operators—an estimate that is indorsed by every pupil and *savant* who ever came in contact with him. Prof. Oliver Lodge is now one of the foremost scientists of Great Britain, a pioneer in wireless telegraphy. In fact, it may be safely asserted that the present advanced condition of wireless telegraphy is due in no small measure to Prof. Lodge's numerous investigations and lucid descriptions of the phenomena of the Hertzian waves.

Sir Oliver Lodge was born on June 12, 1851. At fourteen years of age he entered his father's pottery business, where he remained for six or seven years. During this period, hard and incessant work throughout a long day left him but little time for recreation or the improvement of his education. One day he happened to pick up an old monthly number of the English Mechanic, and became deeply interested in its contents. This was his first acquaintance with science, for, as he states, he "never knew there was such a thing as science while at school." Perusal of this stray copy of a popular technical periodical deeply interested him. He continued his studies in a somewhat rhapsodical manner, picking up what bits of knowledge he could from articles in a penny encyclopedia, and attending lectures at the Wedgwood Institute in his native town.

While on a visit to London during his boyhood, he attended some stray classes on geology and other subjects at the King and University colleges, and also six lectures on heat delivered by Prof. Tyndall. The fascination of this subject was so great that young Lodge, as he himself remarks, "realized that he was a born physicist." Every minute of his spare time he devoted to the study of mathematics, physics, and chemistry, and by this means succeeded in matriculating at the University of London with honors in physics. He then studied chemistry under Frankland in the advanced laboratory at South Kensington, and for a session was a pupil of the late Prof. Huxley.

At twenty-one years of age he abandoned his father's successful business and studied mathematics at University College, under Henrici and Prof. W. K. Clifford, and physics under Prof. Carey Foster.

Three years later, in 1875, he took his B.Sc. degree and succeeded to the office of demonstrator of physics at the University, which fell vacant at this time. This year also signalized his first contribution to scientific literature, for he published, in conjunction with Prof. Carey Foster, several papers on the flow of electricity in a plane conductor, in which the forms of the lines of flow and equipotential lines are found practically and mathematically, for various shapes of conductors, and for different positions of the electrodes.

The following year he constructed a model which he exhibited before the British Association for the Advancement of Science. The object of this was to afford a mechanical demonstration of the passage of electricity through metals, electrolytics, and dielectrics, as theorized by Maxwell.

During the next few years Prof. Oliver Lodge was very prominent in the scientific world in connection with electric phenomena. In June, 1877, a paper was issued by him, in which he described a modification of the system advanced by Mance for the measurement of battery resistance. In this method he utilized a condenser for the purpose of supplementing the ordinary Wheatstone's bridge galvanometer, which was generally adopted in connection with this work. This contribution was followed by another valuable suggestion for a standard Voltaic cell. The feature of this latter device was the prevention of contact between the sulphate of copper solutions and the zinc rod. He advocated two ideas by which this end might be achieved. In one the sulphate solution was to be diffused through a long column of sulphate of zinc, and the alternative scheme was to employ a fine capillary layer of the latter substance, by means of which the two liquids might be brought into contact with one another.

Another great work was carried out by Prof. Lodge

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in conjunction with Prof. Chandler Roberts in 1879. This was in connection with the thermal conductivity of metals and crystals. This was an original branch of research, and has since proved of great value to science. They carried out a series of measurements concerning the resistance of some alloys of copper and tin, in the course of which they discovered the curious behavior.

Dr. Lodge has been intimately connected with the remarkable development of telegraphy during the last twenty-five years, not only concerning its actual progression and improvement, but also the various physical problems closely allied thereto. When the telephone and the Hughes induction balance came into vogue, the question of mutual and self induction came into prominence, and physicists as a whole were closely concerned in investigating this phenomenon. Foremost among these investigators was Sir Oliver Lodge, who advanced our knowledge upon the problem by the publication of a mathematical tneory of intermittent currents and the induction balance. This pamphlet excited widespread attention, for not only did the author therein explain and amplify the facts observed by Hughes; the explanation of the effects produced by making and breaking a circuit; but it was of inestimable benefit to students. Not only was the subject discussed exhaustively, but it was treated in such a comprehensive and lucid manner, that students were able to grasp the action of self and mutual induction in closed circuits.

Sir Oliver Lodge gained his degree of Doctor of Science in 1877. Four years later he succeeded to the Professorship of Physics and Mathematics at the Liverpool University College, which post he retained until 1900. Shortly after his appointment he persuaded the municipal government of that city to establish a large physical laboratory, the construction and equipment of which he personally supervised. The most salient feature of this institution is its democratic character. It is principally intended for the training of mechanics and laborers during the evening after they have finished their daily tasks, so as to perfect them in the knowledge, both theoretical and practical, of their respective trades or the inculcation of another. During the daytime it is utilized for the preparation of students for their various examinations.

As the University under his ægis developed to such an extent, whereby his duties were so increased that he had no time for the prosecution of his scientific researches, a separate chair for mathematics was endowed, and Prof. Lodge simply retained the professorship of physics.

He now carried out a series of experiments concerning the behavior of electric accumulators under a variety of aspects. He devised plates composed of various materials, and also different liquids, the object of which was to determine the combination which yielded the maximum of efficiency. It was during these experiments that he discovered that the sudden failure of, or deficiency in, the E. M. F. of ordinary secondary cells is attributable to the deposit of lead sulphate upon the negative plate.

Prof. Oliver Lodge was the first to measure directly the velocity of the hydrogen ion. This was accomplished in the following manner: A horizontal glass tube was filled with a solution of sodium chloride in solid agar-agar jelly, and this was connected to two vessels containing diluted sulphuric acid. The sodium chloride solution was rendered alkaline with a trace of caustic soda. A little phenol-phthalein was also added, so as to betray any evidence of the hydrogen ion through the tube by discoloration of the solution. An electric current was then transmitted from one vessel to the other. The hydrogen ions from the anode vessel of acid were thus carried along the tube, forming hydrochloric acid during their passage, which decolorized the phenol-phthalein. By this experiment the velocity of the hydrogen ion through a jelly solution under a known potential gradient was observed to be about 0.0026 centimeter per second. The result of this test was to support conclusively the theory which had been advanced some time previously by Kohlrausch.

It is to this eminent electrician that we owe the extension of our environment of knowledge of electric waves, since he has made this phenomenon one of his special studies during recent years, and has considerably added to Hertz's investigations upon the same subject. His experiments with the Leyden jar discharges and waves in conductors are well known. In these experiments he showed that electric pulsations travel over isolated wires with the same velocity as light.

He was also one of the pioneers of wireless telegraphy, and although perhaps he did not devise the first wireless telegraphic apparatus, he rendered communication possible through space without wires to a very appreciable extent by his coherer. He made a close study of the action of electric waves in reducing the resistance of the contact between two metallic surfaces, such as a plate and a point, or two balls, and named this device the coherer. The earliest form of coherer made by Prof. Lodge comprised simply a glass tube a few inches in length containing iron turnings, with contact plates or pins at the end. When this tube is placed in series with a single voltaic cell and a galvanometer, the resistance of the tube is nearly infinite. When an electric spark is created near the tube, the resistance is diminished, and the deflexion of the galvanometer is increased. This deflection of the galvanometer he observed could be used to indicate the arrival of the electric waves, but he found that the tube had to be tapped between each experiment, and the deflexion of the galvanometer returned to approximately its original position.

In 1894 he exhibited at Oxford his first "tapperback," or automatic system of decohering the iron filings after each impulse. It was this ingenious discovery which has rendered it possible to develop wireless telegraphy to its present advanced stage of perfection. Sir Oliver Lodge, in collaboration with Dr. Alexander Muirhead, has devised a very scientific system of wireless telegraphy, which is now in operation in Great Britain, which was described in the SCIENTIFIC AMERICAN.

In 1898 Sir Oliver Lodge theoretically examined the conductive system of wireless telegraphy. He constructed an experimental system, wherein the primary and secondary circuits were syntonized by the inclusion of condensers in the circuits. Prof. Lodge demonstrated that by syntonizing, the circuits are rendered inductively respondent to each other with a much less power expenditure in the primary circuit than is the case where *no* tuning is adopted.

In 1883-84 Prof. Lodge, in collaboration with the late Mr. J. W. Clark, carried out some very important scientific investigations. Prof. Tyndall some time before had drawn attention to the existence of a dark plane that is always to be observed when dusty air surrounds an illuminated body, and discussed the cause of its existence. Prof. Lodge and Mr. Clark carried out a series of researches upon this curious behavior of dusty air under such conditions, and set forth the results of their efforts in an important paper upon the subject, wherein they set forth the cause for the existence of the dark plane which had attracted Prof. Tyndall's attention. Incidentally they also succeeded in rediscovering the extraordinary effect of electrifying dusty air, which had originally been discovered by M. Guitard some thirty years previously, but had not attracted that widespread attention which it deserved. It had therefore been absolutely forgotten until Lodge and Clark once more brought it under review.

Sir Oliver Lodge, owing to his paramount position in the electrical world, and the many valuable researches which he has carried out in connection with electrical phenomena, has received several decorations from the scientific societies of Great Britain in appreciation of his work in this connection. He is a fellow both of the Royal and Physical societies, and is a Rumford medalist. Owing to his unique electrical knowledge, he has held many important appointments as adviser to special committees, etc. For two years, 1884-6, he was the scientific adviser to the Electrical Power Storage Company. For some time he was secretary of the electrolysis committee of the British Association for the Advancement of Science, during which time he made several important communications to, and translated several foreign discussions upon the subject for the committee. In 1885 he acted as one of the jurors at the International Inventions Exhibition. In 1900 he was appointed principal of the University of Birmingham, a position which he still holds.

His connection with the British Association is of very long standing. He delivered an important lecture upon the subject of "Dust" before this august body at the Montreal meeting in 1884. He was one of the secretaries of Section A of the British Association, and had the honor of opening the first discussion before that section, being on "The Zeal of Electromotive Force in the Voltaic Cell." Owing to his lucid, comprehensive, and expert expounding of the subject on this occasion, he was voted to open a discussion on electrolysis at the next annual congress at Aberdeen. In 1888 he took part in another discussion at the Bath meeting on lightning conductors, and so important and valuable was his communication, that at a later date he published a volume dealing with "Lightning Conductors and Lightning Guards," which is now regarded as a standard work. These electrical guards are of great value for cables, telephones, and electric lighting circuits, and are constructed by Dr. Alexander Muirhead, the collaborator in his recent wireless telegraphic apparatus. In 1891 he was president of Section A of the British Association at the Cardiff meeting. He has delivered many important lectures at the Royal Institution of Great Britain upon a wide range of electrical science, such as the "Deposition of Dust and Fume by Electricity," "The Leyden Jar," and "The Aberration of the Earth through the Ether." The latest theory of his which has excited worldwide attention is that which he recently advanced at Oxford on "Electricity and Matter," which has been fully described in the pages of the SCIENTIFIC AMERICAN SUPPLEMENT.

Prof. Oliver Lodge has a remarkably clear, terse, and comprehensive method of describing his theories and ideas, and he can excite the interest of even the most amateur mind. This trait is of invaluable advantage to him as a lecturer before a class of students, and is much appreciated by them. With the university students he is extremely popular, owing to his untiring energy in assisting them in their studies, and his generous assistance to them in the solution of any difficulties or the explanation of any abstruse problems. By his assistants he is regarded as a friend, owing to his kindness, thoughtfulness, and sympathy.

His contributions to scientific literature are of a very diversified and important nature, while he has compiled many volumes describing difficult subjects in a most popular manner. His most important works comprise "Elementary Mechanics," "Modern Views of Electricity," "Pioneers of Science," "The Work of Hertz and His Successors," "The History of Wireless Telegraphy," and "Signaling Through Space Without Wires." In addition he has also contributed innumerable papers upon various scientific subjects.

Like Sir William Crookes, Sir Oliver Lodge is also a deep student of the occult, and the subject of telepathy, and has written many papers upon the subject for the Psychical Research Society, of the council of which body he is a member.

Correspondence.

The Græco-Etruscan Chariot.

To the Editor of the SCIENTIFIC AMERICAN:

On looking over the illustrations of the Græco-Etruscan chariot, contained in the issue of November 28, I was led to an interpretation of the panels differing from that of Gen. Di Cesnola; and as it appears to fit the case, I should like to make it known through the columns of your valued paper, in which the illustrations of the chariot appear.

Front panel. Before the Greeks sailed from Aulis to attack Troy, Agamemnon was urged to offer as sacrifice his daughter Iphigenia, in order that the gods might send favorable winds. At the place of sacrifice Diana appeared, snatched Iphigenia away in a cloud and left a deer in her stead, which is shown on the panel of the chariot.

The two figures I would take to represent Thetis giving to Achilles his new armor, in order that he might avenge the death of his friend Patroclus, who had just been slain by Hector without the walls of Troy.

The right-hand panel would represent Achilles in the act of slaying Hector, who was wearing at the time Achilles' armor taken from Patroclus:

> No wish
> Have I to live, or to concern myself
> In men's affairs, save this, that Hector first,
> *Pierced by my spear*, shall yield his life, and pay
> The debt of vengeance for Patroclus slain.
> (Bryant's Trans. Homer.)

The left-hand panel would represent Achilles in the act of dragging the body of Hector around the walls of Troy.

The two nude figures might represent the two Trojan maidens Cryseis and Briseis, captured by the Greeks, the latter of whom was the cause of the death of Patroclus indirectly, Achilles having for a while refused to fight. ARTHUR CHIPPENDALE.

The American Club, City of Mexico, December 6, 1903.

An Artificial Substitute for Pumice.

Artificial pumice is made in quantities in Bietigheim in the valley of the Enz in Germany, which is said to be a valuable substitute for the genuine stone. It is made from ground sandstone and clay, and there are ten kinds, differing from each other in regard to hardness and grain as follows: (1) A hard and a soft kind with coarse grain, particularly useful in the leather, wax-cloth, felt, and wood industries; (2) a hard and soft kind with medium coarse grain, suited to stucco workers and sculptors and particularly useful for polishing wood before it is painted; (3) a soft, fine-grained stone for the white and dry polish of wood and for tin goods; (4) one of medium hardness with fine grain, for giving the wood a surface for an oil polish; (5) a hard, fine-grained one for working metals and stones, especially lithographic stones; and finally pumice stones with a very fine grain. These artificial stones are used in pretty much the same way as those of volcanic origin. For giving a smooth surface to wood, a dry stone is applied, but to give it a fine polish the stone is dipped in oil. For fine work no coarse-grained and for coarse work no fine-grained stones are used. The unreliability of pumice, both in grain and hardness, variations being noted even in the same piece, suggested the idea of replacing it with the artificial product.

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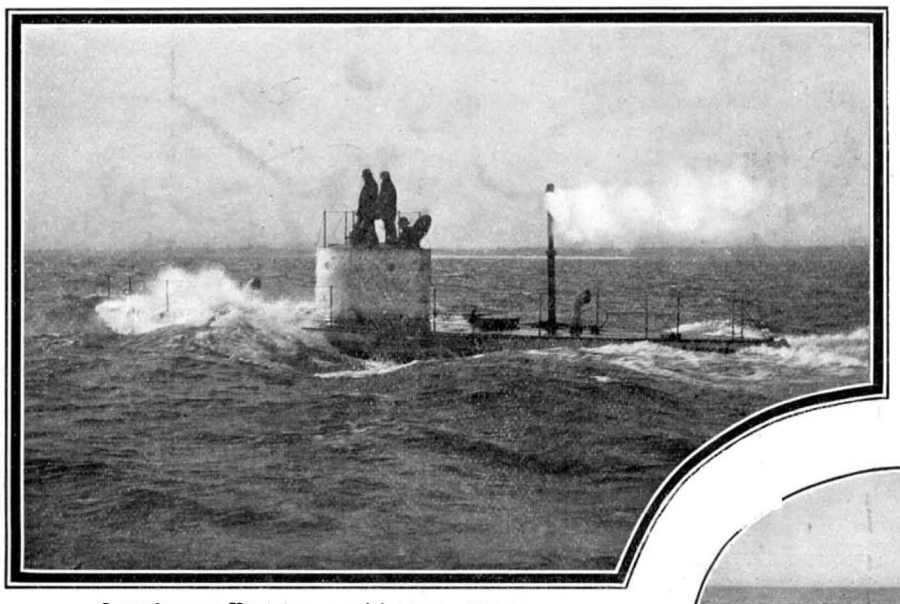
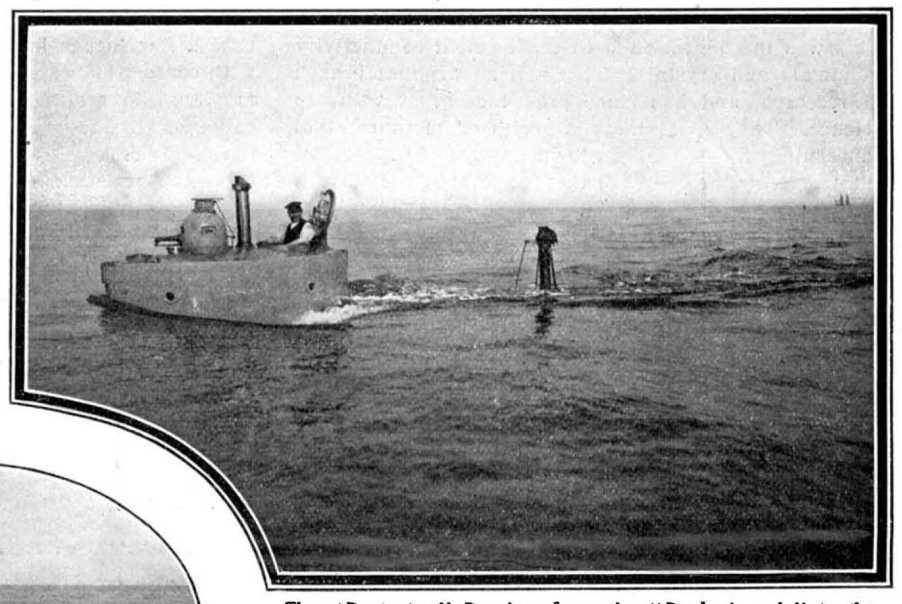
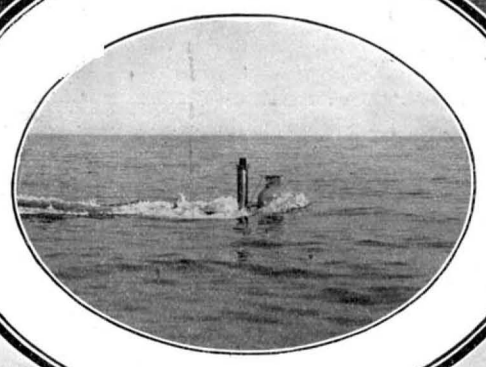
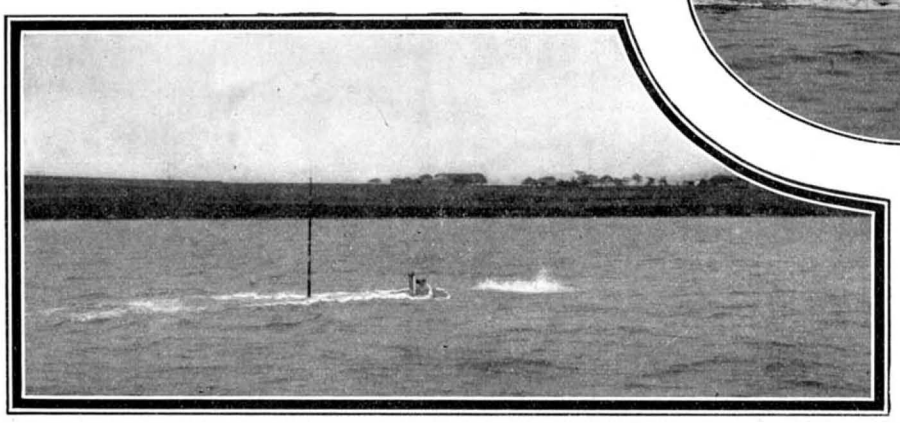


Running at Half Speed with Deck Awash.

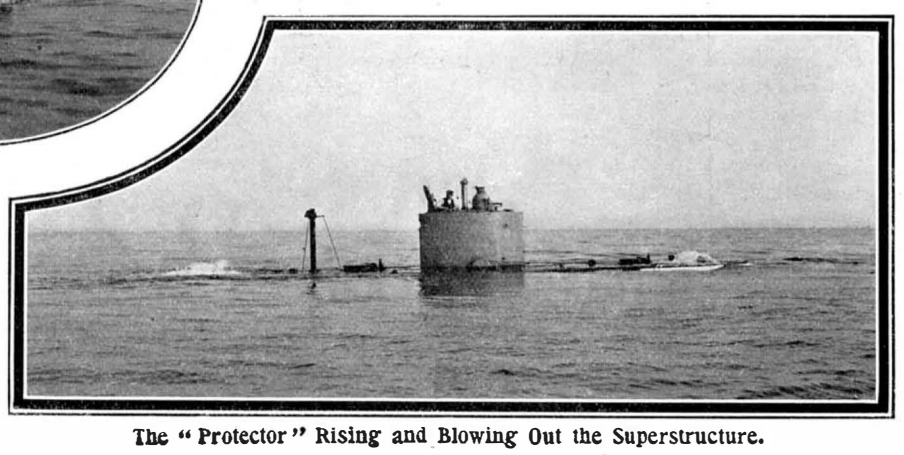


The "Protector" Passing from the "Deck Awash" to the "Conning Tower Awash" Degree of Submergence.

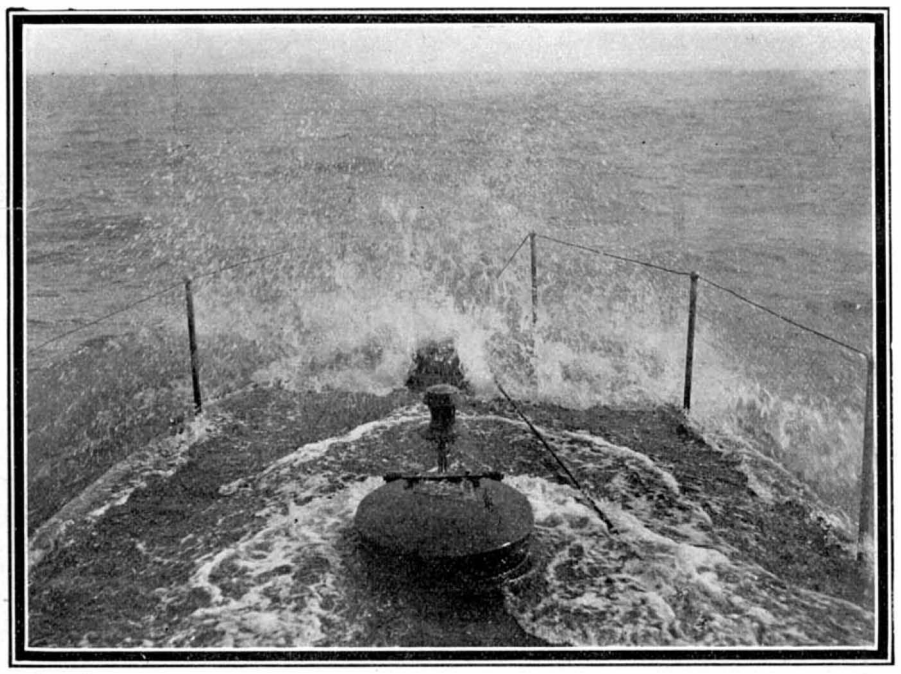




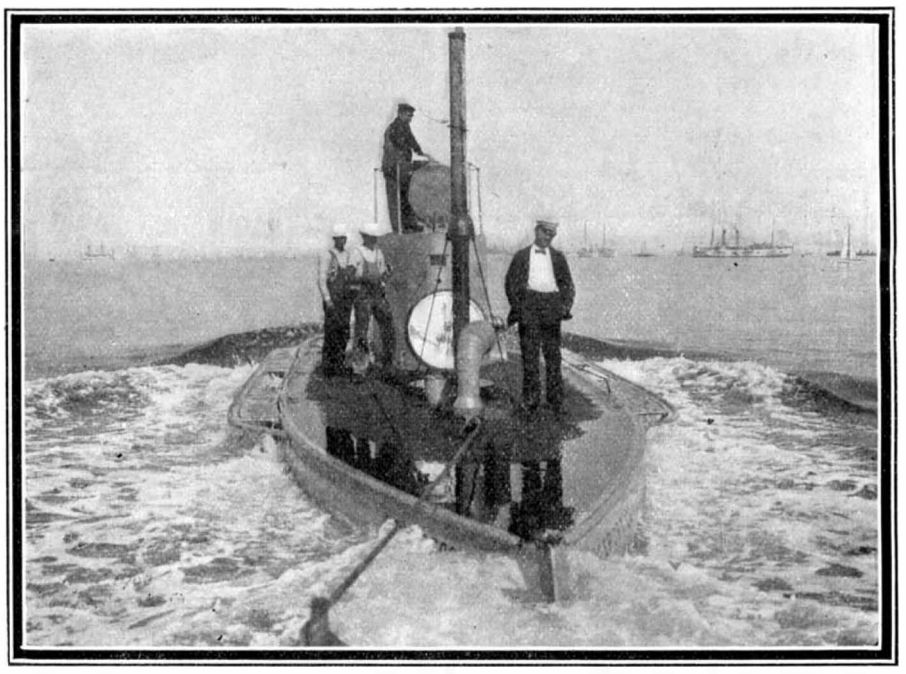
The "Protector" Discharging a Torpedo.



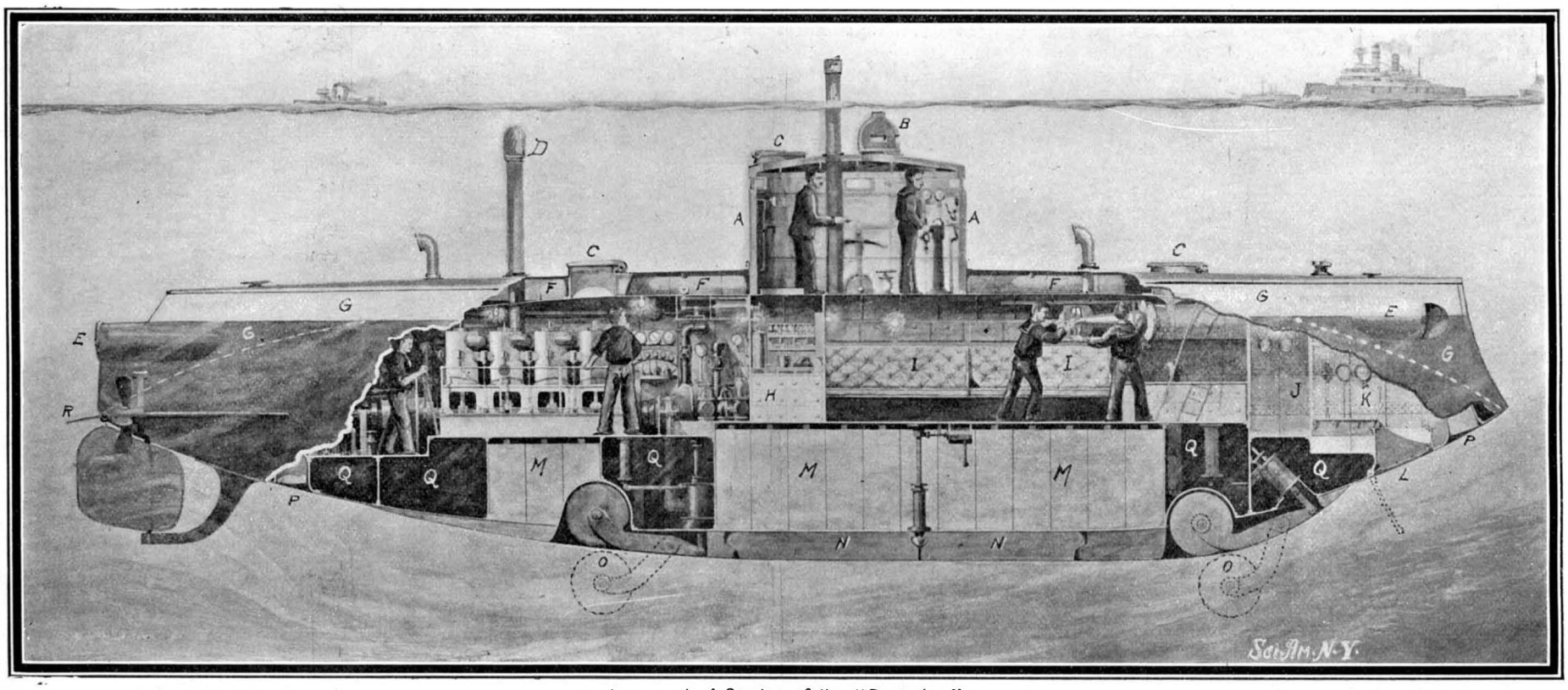
The "Protector" Rising and Blowing Out the Superstructure.



Bow Wave from the Conning Tower When Running with Deck Awash.



Stern View of Boat Cruising, Showing Hydroplanes on Each Side and Hatches Open.



Longitudinal Section of the "Protector."

A, *A*, Bronze conning tower; *B*, Sighting hood; *C*, *C*, Hatches; *D*, Exhaust from engines; *E*, *E*, Torpedo tubes; *F*, *F*, Gasoline tanks; *G*, *G*, Line of Spindle hull; *H*, Galley compartment; *I*, *I*, Crew space; *J*, Air lock; *K*, Diving compartment; *L*, Diving door; *M*, *M*, Storage batteries; *N*, *N*, Drop keel; *O*, *O*, Wheels; *P*, *P*, Anchor weights; *Q*, *Q*, Ballast tanks; *R*, Horizontal rudder.

THE LAKE SUBMARINE TORPEDO BOAT "PROTECTOR."

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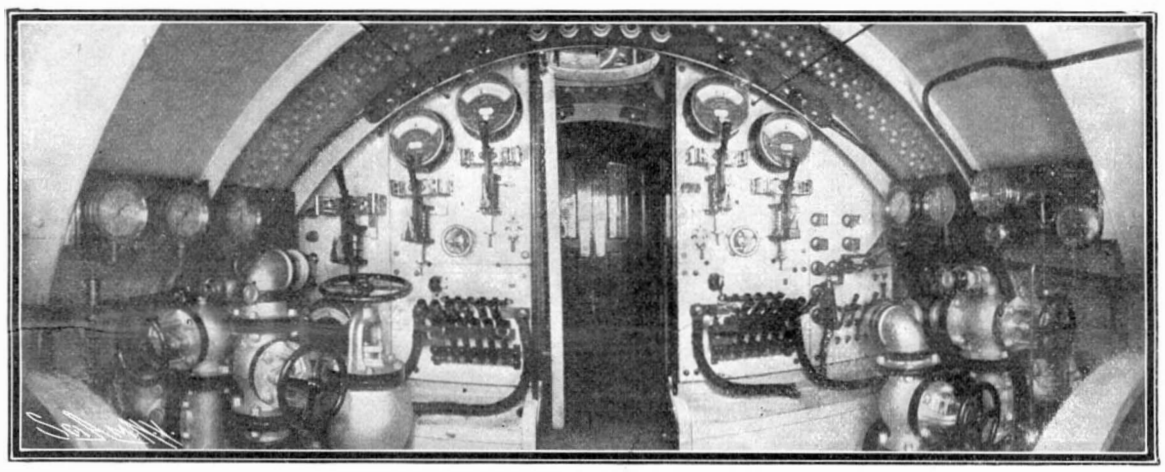
THE LAKE SUBMARINE TORPEDO BOAT "PROTECTOR."

With the launch of the torpedo boat "Protector" on November 1 of last year—an event which was illustrated at the time in these columns—there was for the first time put afloat a novel type of submarine torpedo boat, the tests and trials of which have in large measure fulfilled the expectations of the inventor, and of all those who look for an improved type of submarine that can be made useful for coast defense and the cutting of mine cables, as well as for attacking an enemy's ship should it enter a harbor or other protected body of water.

In this article we will outline the main features of the boat, while for a more detailed description we refer our readers to the article by Lieut. John Halligan, Jr., in the current SUPPLEMENT.



Front End of Engine Room, Showing Switchboard and Valves Controlling Flow of Water into Five Ballast Tanks.

The gages indicate water in tanks. The flywheels of the two engines are seen in the lower corners of the photo, which was taken looking through the galley and at the closed doors of the cabin. A glimpse may be had of the interior of the conning tower through a manhole in the top of the galley compartment.

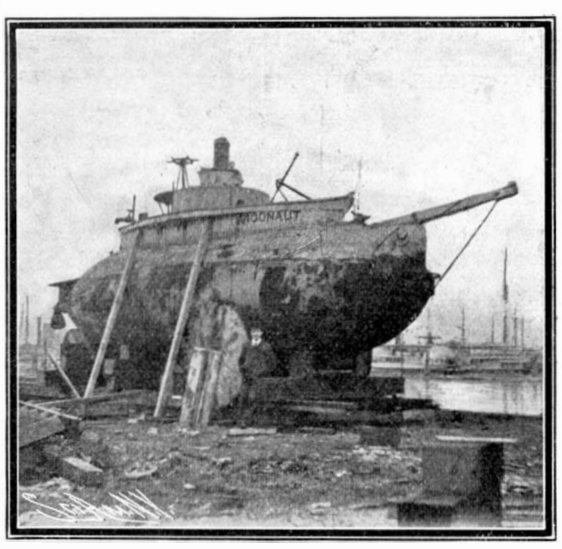
Like that of most other submarines, the main structure of the "Protector" consists of a spindle or cigar-shaped hull of steel plates 65 feet long by about 11 feet greatest diameter. On top of this hull has been built a superstructure, which gives the boat the appearance above water of having an ordinary torpedo-boat hull, with a conning tower mounted in the center. Within the superstructure, designated by *G* in the cross-section, there are carried eight gasoline tanks, *F*, having a total capacity of 1,050 gallons; two lubricating oil tanks of 120 gallons total capacity; six high-pressure air tanks formed of 8-inch Mannesmann tubes and containing 21 cubic feet of air at a pressure of 2,000 pounds per square inch; and four low-pressure air tanks containing 12½ cubic feet of air at 60 pounds pressure. The pressure is reduced from 2,000 to 60 pounds by means of a Foster reducing valve. The superstructure has a water-tight bulkhead across its center, which divides it into two huge water tanks that are the first to be filled when submerging. Another tank (not shown) is located in the center of the boat beneath the storage batteries, *M*, while the five other ballast tanks, *Q*, are disposed symmetrically about the bottom of the hull. The diving compartment, its door, and the air lock are shown at *K*, *L*, and *J*; the galley and cabin at *H* and *I*, with torpedo tubes projecting from the latter through the hull on each side at *E*, and a third tube projecting from the engine room through the stern; the conning tower and sighting hood are seen at *A* and *B*, while the three hatches are lettered *C*, and the exhaust pipe of the engines, *D*. *P P* are detachable anchor weights; *N N* a detachable keel; and *O O* the buffer wheels operated by hydraulic rams, which ease the shock when the boat strikes bottom, and upon which she runs, driven, however, by her propellers, when a good opportunity occurs.

The engine room in the rear of the boat is a marvel of compactness, and when one sees the two 125-horse-power, four-cylinder, White & Middleton gasoline engines, one on either side of a narrow aisle, one wonders how they were ever got in there, much less how they can be made to operate satisfactorily in such close quarters. Yet the fact is they are two of the most reliable pieces of machinery in the boat, and, started, if need be, by the explosion of a cartridge in one cylinder, they will run for hours without giving trouble, seeming to have, apparently, all the reliability of a stationary gas engine. A magneto is regularly used for the ignition current. Directly back of each engine is a 50-horsepower, shunt-wound, Diehl electric motor, which is connected to the engine on one side and to the propeller shaft on the other through friction clutches. Ordinarily, the engine is started by the motor, after which the clutch operating the propeller is thrown in and the brushes are lifted from the motor commutator if a long run is to be made. If the battery needs recharging, this can be done while the boat is running by altering the pitch of the screws, thus driving the boat more slowly and using the surplus power to run the motors as dynamos and allow them to recharge the battery. This consists of sixty cells of Gould battery weighing 75,895 pounds, and capable of furnishing 1,680 amperes, or 85½ horse power, for three hours, which gives the craft a radius when submerged of 18 to 20 miles. By means of a special valve in the top of the sighting hood, which supplies air for the motors, it is possible to run on the engines till this hood is nearly submerged; and by placing a similar valve in the end of the omniscope, the inventor hopes that he will eventually succeed in being able to use the engines for propulsion when all but a short length of the tube is submerged. This would make it possible to creep up quite close to an enemy under engine propulsion, and cause the electric motors to be used only for the very end of the approach, when about to torpedo the enemy.

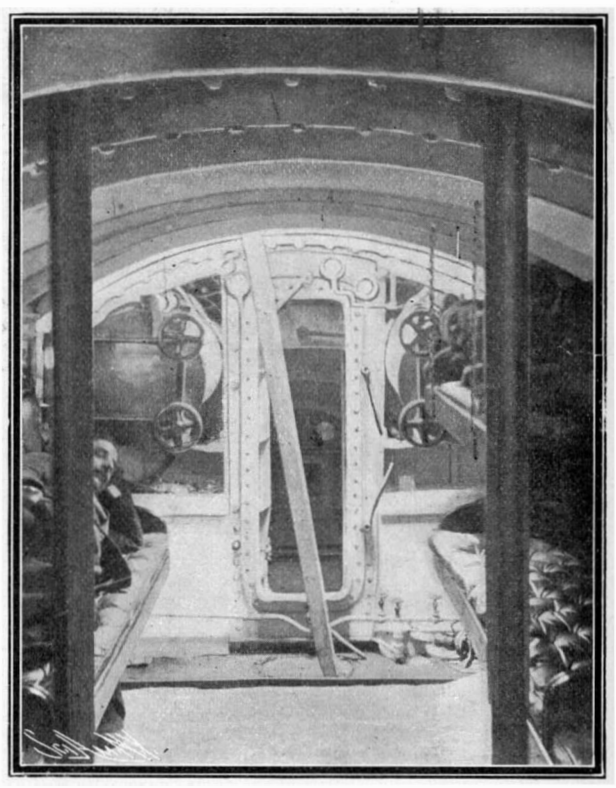
Let us place ourselves in the conning tower of the "Protector" while she is running in cruising trim on the surface. Suppose we discover an enemy's warship some miles distant. Our captain at once takes the precaution to make our craft as inconspicuous as possible, and, opening the valves of the superstructure, he allows the water to flow into it through two grated holes on the side, which causes the boat, in 15 minutes time, to submerge to the base of the conning tower. Water is then let into the main central ballast tanks and the other ballast tanks if necessary, till the conning tower is submerged to the base of the sighting hood, which occurs in about three minutes. We watch the enemy through the sighting hood lenses, until, when about two miles away, our commander orders the engines stopped. As soon as we are running by electricity, he gives the hydroplane wheel a turn, and we are drawn completely under, though we can still see the enemy through the omniscope. The hydroplanes are four long boards (two forward and two aft) which, when all are tilted slightly at the same time, overcome the 280 pounds reserve buoyancy that the boat has at this stage of submergence, and draw her still further below the surface, yet on an even keel. Her depth below the surface is then controlled by the angle at which the hydroplanes are set. Any slight change in longitudinal trim can be compensated for by means of a horizontal rudder, though such changes of trim due to the movement of the men are negligible.

But to return to the attack. The warship is running at right angles to our course. We cannot reach her before she passes us unless we change it. We turn our boat at about the angle which we think will enable us to get within torpedo range before the enemy can pass us. Soon we are getting quite close. We change the angle of the hydroplanes slightly, and the omniscope tube

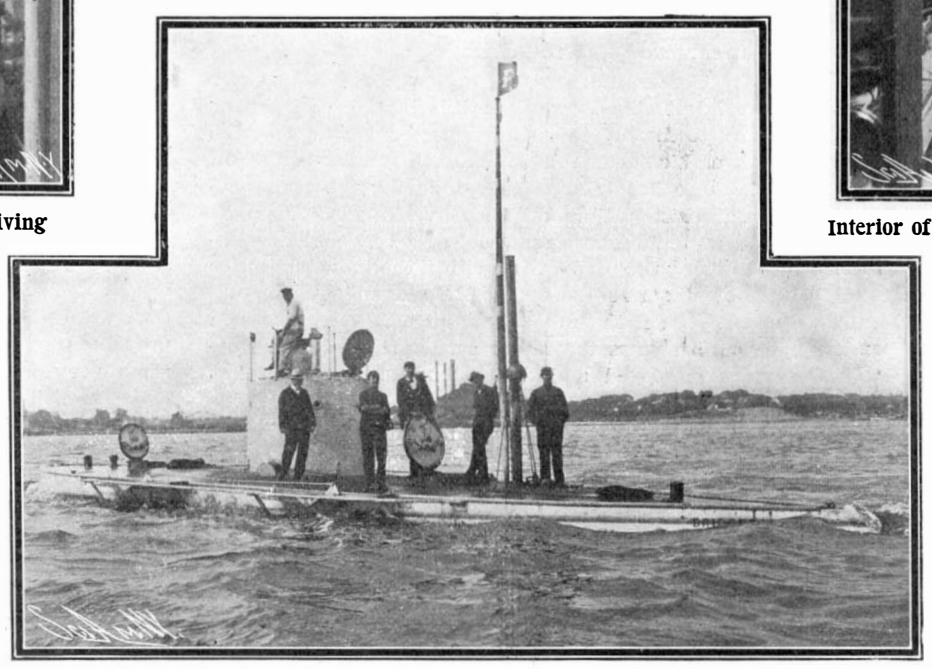
Paying Out Diver's Cable Through Diving Compartment Door.



"Argonaut the First."



Interior of Cabin, Looking Forward Through Air Lock Door Into Diving Compartment, and Showing Torpedo Tubes and Berths.



The "Protector" in Cruising Trim, with Hatches Open, and Showing Operating Rod Connecting the Two Hydroplanes, as Well as Exhaust Pipe, Omniscope, and Sighting Hood.

A man is sitting on the Sighting Hood, and the Omniscope projects through the roof of the conning tower just behind it.

THE LAKE SUBMARINE TORPEDO BOAT "PROTECTOR."

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disappears below the surface. We steer by the compass now till we think we are within range. The torpedoes in all three tubes are ready for firing. The omniscope man is peering into the instrument as we rise slightly for a final observation. The sailors on the enemy's deck, as seen through the "full size" lens, do not quite fill the measured space on the ground glass. "Two hundred yards more to go; 10 degrees more to starboard," says the man at the omniscope, as the top of the instrument again plunges below the surface. The course is changed as directed. A minute later the captain gives orders to the man at the torpedo tubes to make ready, and in 15 seconds more the order comes to fire. The torpedo is launched, and we rise sufficiently to see its effect. A glimpse through the omniscope shows this to be *nil*. The vessel is well within range, and it seems as though she must certainly have been struck. Another torpedo is launched and is seen to bob up at the enemy's stern. A hail of rapid-fire shells comes very near hitting the omniscope, and warns us that we are seen. Down we go again, aiming straight for the battleship. With the electric motors running at their highest speed, we hold our course for between two and three minutes, all the time going deeper, as shown by our depth gage. Now we rise again quickly. We have passed under the battleship. The crew are ready with the rear torpedo, and the moment the omniscope emerges, the observer orders a sharp turn to port. As the boat answers her rudder, the order to fire goes to the engine room. With a whirring noise, the rear torpedo leaves its tube, and a moment later we rise to reconnoiter.

Although we might resume the attack, since we have two more torpedoes at our disposal, that is unnecessary, as the battleship has crowded on full steam and is making rapidly for the shore. She takes on a heavy list to port, and the evident intention is to beach her.

We decide to go inshore, therefore, and send word that we have captured our prey. By changing the inclination of the hydroplanes, we again rise and proceed under gasoline engine propulsion as soon as the sighting hood top is out of water. After a half-hour's run, we again submerge near a buoy, running down till our wheels strike bottom. More water is then let in the ballast tanks, which holds us there. Two men enter the diving compartment, and, after tightly closing the air-lock door, let in compressed air till the two pointers on the combined water and air gage match. The door is then lowered, and word is telephoned the engine room to go ahead slowly. The men watch the smooth, sandy bottom as the boat rolls over it on her wheels. In a few minutes the cable is found, hauled in, and connected to the boat's shore telephone circuit. The bow and stern anchor weights are dropped, and as the cables are paid out, we rise vertically to the surface. After telephoning ashore the results of our brief cruise, we drop the telephone cable, and, having blown out our ballast tanks and superstructure, we haul up the anchors. The engines are started and we steer for port, having accomplished our purpose. We do not know what our next expedition will be, but we can carry fuel enough for a cruise of 1,000 miles, should we be sent on a mission to the enemy's country, such as for cutting the cables of the mines in his harbors and blowing up his ships in their own ports.

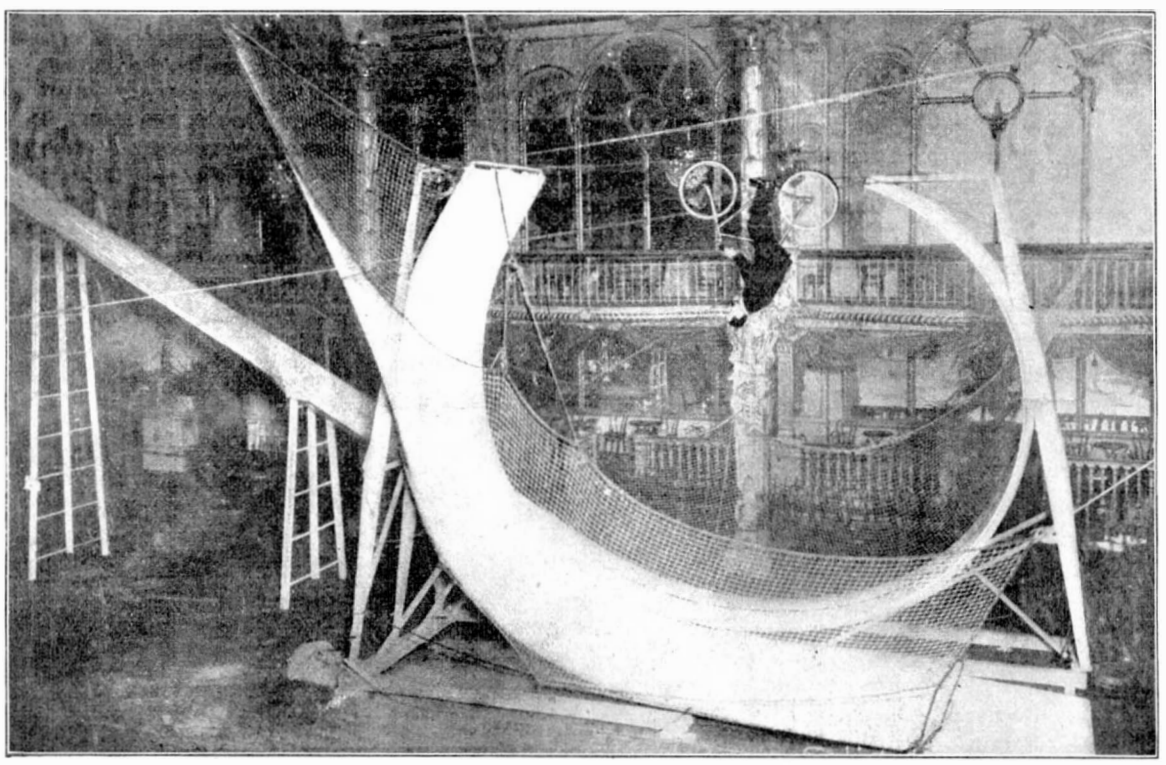
The above description of a supposed trip on the "Protector" shows the many advances Mr. Lake has made in the art of submarine navigation. Very few of the feats performed by the "Protector" have been accomplished by previous types of this sort of craft, the operations of which have heretofore been confined to land-locked waters and have been carried on with considerable jeopardy to the crew. Boats of the Lake type, if built on a larger scale, can be made to carry fuel and provisions enough to cross the Atlantic, and in fact, to cruise anywhere that a torpedo boat is capable of going. Besides this, they would be capable of attacking an enemy unawares, and thus with a good chance of sinking him wherever on the high seas they might chance to meet, as well as of entering his harbors and cutting mine cables or doing any other work that can be accomplished beneath the surface.

THE LATEST FORM OF "LOOPING THE LOOP."

"Looping the Gap" is the pleasantly suggestive name which has been given to a wild French variation of the American "Looping the Loop."

The apparatus is simply an ordinary "Looping the Loop" track, the upper segment of which has been cut out to leave a gap, across which the rider must leap as he whirls around the circle. The rider who trusts himself with foolhardy daring to this apparatus, and is nightly cheered at the Folies Bergères in Paris, is M. Ancilotti.

Considering this apparatus in the light of the laws of centrifugal force, it would seem as if M. Ancilotti ought to fly off at a tangent into space when he reaches the gap, instead of crossing the gap and landing safely on the other side. Still we have the London Illustrated News' statement that the rider does just what is claimed, to which journal we are indebted for our illustration and particulars.



THE LATEST AND WILDEST VARIATION OF "LOOPING THE LOOP."

Peat Coal by Electrical Process.

The steadily growing consumption of fuel for the various purposes of manufacture, transportation, and domestic economy, together with the gradual but inevitable exhaustion of firewood in most civilized countries, have combined to give during recent years a new and important interest to the utilization of the vast beds of peat which have hitherto lain almost neglected in many portions of Europe and America. Peat in its ordinary condition contains about 80 per cent of water. All the earlier methods of utilizing it involved the elimination of this by air drying, which is tedious and uncertain in wet, cloudy weather, and practically ceases in winter. The problem has been, therefore, to devise a process which would carbonize and convert the substance of peat into coke or coal by the consumption of its gaseous elements, a process which should be self-sustaining, simple, and so cheap in operation as to produce carbonized peat at a cost below or not far exceeding the average price of bituminous coal.

The latest step forward in this branch of industry appears to have been made in England, where at the works of Messrs. Johnson & Phillips, at Charlton, in Kent, there has been exhibited during the past fortnight an electrical process for converting ordinary peat into firm, smokeless steam coal at a cost which promises to bring the product far within the industrial price limit of steam fuel in Great Britain and Continental Europe. From the numerous and elaborate report in the English press the following description of the apparatus employed and its method of operation has been derived:

The peat is cut and excavated by machinery, loaded into dumping cars which convey it from the bog to the plant, where it is packed into rotary iron cylinders of a peculiar construction. The cylinders being rotated at high velocity, the centrifugal pressure, aided by an interior beating device, expels all but a small remnant of the 80 per cent of water which the material originally contained. Electrodes connected by conductors with a dynamo are then inserted in the cylinders in such a manner that the mass of centrifugally dried peat becomes the medium through which is completed the circuit between the electrodes. The resistance offered by the peat, like the filament of an incandescent lamp, generates heat which carbonizes the material, producing a mass of disintegrated black globules, which retain all the valuable elements of the original material. This part of the process, which depends largely upon the conductivity of the peat, may be promoted by moistening the mass with certain cheap liquid chemicals, the use of which is covered by the patent.

From the cylinders the carbonized material passes to machines, which knead it into a putty-like mass, which is then pressed into briquettes or left to dry and harden in masses, which are broken into lumps, screened, and graded like ordinary coal. Among the special advantages claimed for this method is the fact that the electrical current converts but does not destroy any of the valuable elements of the peat, whereas coking by fire heat expels a large percentage of these elements in the form of gases, which, being either wasted or burned as fuel beneath the retorts, are lost from the composition of the ultimate product.

Briquettes produced by this method can be compactly stowed on shipboard or elsewhere; they are practically smokeless, leave no clinkers whatever, and, according to English press reports, have the high thermal value of 9,000 British units. The cost of a plant capable of treating 100 tons of peat per day is stated to be £4,000 ($19,466). The actual cost of producing a ton of peat fuel by this process is stated to be 5s. ($1.21), equal for all steam-generating purposes to a ton of South Wales steam coal, which costs at the mouth of the mine 8s. 4d. ($2.02). These are given as the economic results in a location where the electric current used by the process is generated by steam. In districts where generators can be driven within a working radius of peat bogs by water power, the cost of production would be proportionately reduced.

There are in New England and in the Middle and Western States vast beds of peat that have been heretofore left neglected as waste material in the economy of nature. In Alaska and on the islands which lie along its shores—where the limited supply of coal brought from British Columbia sells for $25 per ton and men perish from cold for want of fuel—there is a practically unlimited supply of peat of the best quality, all of which would be available as fuel if carbonized and converted into coal or briquettes. No process which includes air drying or works the peat at ordinary temperatures would be practicable there for more than a small part of each year—the brief arctic summer of that northern clime. If those vast deposits of fuel material are ever successfuly utilized, it must be by some process similar to those herein described, whereby the peat is quickly machine dried by means independent of sun or wind and then carbonized by heat that can defy even the cold of an arctic winter. This electrical method will be first tried on an industrial scale in Ireland, an island which, with a total area of 32,393 square miles, has 2,830,000 acres of peat.

A Successful Experiment with a Motor-Driven Aeroplane.

On December 17 the Messrs. Orville and Wilbur Wright made some successful experiments at Kitty Hawk, N. C., with an aeroplane propelled by a 16-horsepower, four-cylinder, gasoline motor, and weighing complete more than 700 pounds.

The aeroplane was started from the top of a 100-foot sand dune. After it was pushed off, it at first glided downward near the surface of the incline. Then, as the propellers gained speed, the aeroplane rose steadily in the air to a height of about 60 feet, after which it was driven a distance of some three miles against a twenty-mile-an-hour wind at a speed of about eight miles an hour. Mr. Wilbur Wright was able to land on a spot he selected, without hurt to himself or the machine. This is a decided step in advance in aerial navigation with aeroplanes, and it is probably due to the increased degree of controllability resulting from the Wright brothers' novel form of horizontal rudder, which is a small guiding aeroplane placed in front of, instead of behind, the aeroplane proper. A well illustrated description of the Wright aeroplane appeared in our February 22, 1902, issue. The present aeroplane has the very large surface of 510 square feet, making its apparent entire controllability all the more remarkable.

Practically all the grading for the intramural railway at the World's Fair grounds has been finished. The road will be ready for operation by January 1.

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PEWTER WARE.*

BY RANDOLPH I. GEARE.

A revival of some of the lesser arts, including the ancient and honorable pewter craft, seems to be at hand, judging by the present demands of the public and by the fact that in some countries, England especially, societies are being organized to encourage the production of artistic objects by hand work. Indeed, a limit seems to have been reached in the employment of purely mechanical methods for the manufacture of house utensils or ornaments which might properly have in them something of the artistic temperament, and manual execution of work in metals and wood, embroideries, etc., is apparently to have another renaissance.

A Sixteenth Century Pewter Flagon, Surrounded with Two Bands of Allegorical Figures in Relief.

The fact that there will always be in this country an enormous demand for cheap domestic utensils, since a large proportion of the people *must* have the most inexpensive goods that can be obtained, precludes the likelihood of making more than a small proportion of them by hand. But when such objects are required merely for ornament by those who can afford to pay higher prices, manual work may properly step in and take the place of the machine, so far, at any rate, as the decorative features are concerned.

A plain, unornamented vessel may perhaps be as well cast as made by hand, for there is but little opportunity for the impress of human thought; but when decoration is to be added, the machine can but poorly imitate what the hand, guided by intelligence, can execute. How much more pleasing is the thing which bears the stamp of humanity than the one which, however costly may be the materials employed, has been fashioned solely through the agency of a machine.

The reasons that primarily led to the disuse of pewter were the introduction of cheap pottery and glass, together with zinc, block tin and Japanned iron, while the discovery of more silvery and harder alloys, such as Britannia metal, German silver, nickel silver, etc., also hastened its departure.

Furthermore, the increase of machinery during later years, coupled with a desire for easy and quick riches on the part of manufacturers, has unquestionably had much to do with destroying the lesser arts, and the result has been the turning out of much pseudo-artistic ware in pictures, metal and woodwork, embroidery, etc., to which a stereotyped form of ornamentation, utterly devoid of art though often profuse in quantity and color, has been applied, evidently to catch the eye of the unwary public.

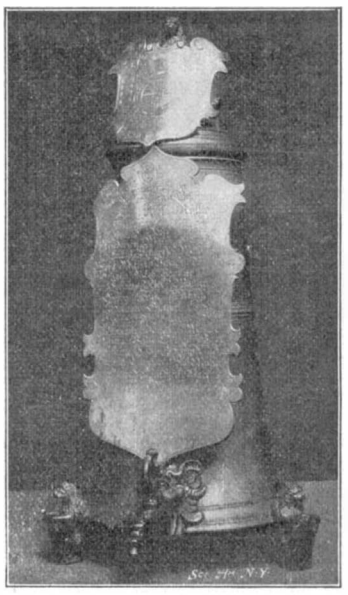
In pewter ware, as in the decorative arts, ornament should be felt rather than seen. The moment it becomes obtrusive it is false and superfluous, and while, in the matter of buildings, ornamentation has been described as too often representing the "wine" of architecture, yet a simple and effective decoration can be given to objects pertaining to any industry, even those of the most utilitarian use.

"True ornamentation," writes an art critic, "arises from within the thing to be decorated. It is the effort of personality to express itself. It is the surface manifestation of the vital energy of art. It conveys sentiments and expresses facts. It epitomizes the history of entire races in a design the size of a man's hand. It must play a part in the thing which it adorns, and must express personality. It must not be a superficial, superfluous, and applied decoration devoid of real meaning. It must be harmonious with the thing decorated."

With the increased intelligence of the present day, it seems probable that, if the pewter craft should be revived, the revival would carry with it at least a fair showing of artistic design, but time alone can show to how great an extent the objects to be manufactured will maintain the dignity which that industry reached in past centuries.

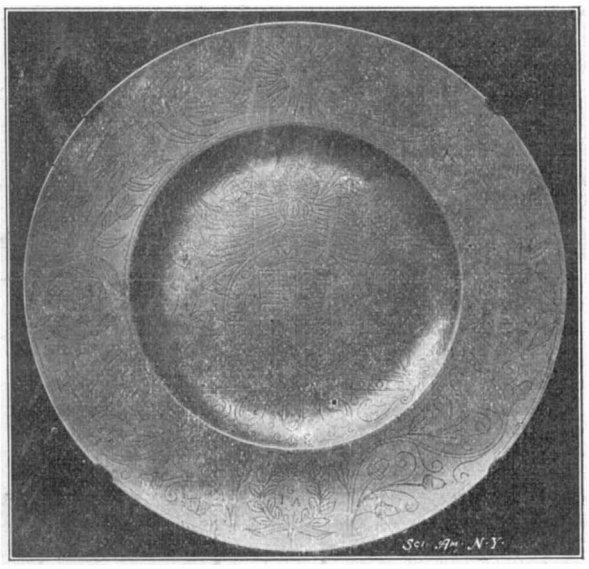
Pewter Salver, Embossed with Medallions, Containing Allegorical Representations. Made by F. Briot in the Sixteenth Century.

In bygone days pewter ware was hammered, spun, or cast into shape. The molds were of brass or gunmetal, very carefully fitted, massive, and consequently costly. The metal was poured directly into them, as with lead and zinc; and if hollow castings were required—for instance, in the case of handles for tankards—the mold was reversed before the metal became chilled through. What was still molten ran out, leaving a cavity in the interior of the casting, just as in the French art zinc work. The surface of the casting needed no touching except where it was to be left plain and bright, and then it was turned on a hand-lathe and burnished. Afterward the castings were usually hammered over, to improve their general appearance and to toughen the metal. Spun, hammered and embossed pewter is no longer produced except in the quality of Britannia metal.



An Old German Tankard, Made in Nuremberg 1695. Height 2 Feet 2½ Inches; Diameter at Bottom, 11 Inches.

In hammered pewter the genius of the worker could best find expression, and some of the most highly decorated specimens were probably produced in this way—such as the Gloucester candlestick, a work of the twelfth century, and now on exhibition in the British Museum; a superb dish in the Louvre collection made for Henri III.; the salver and flagon with medallion portraits of Augustus of Saxony, and other celebrated pieces.



An English Pewter Platter Bearing the Date 1662 and the Arms of Charles II. Diameter, 22 Inches.

Pewter was extensively used for church vessels, and in this connection the old English lead fonts come at once into mind; but though none of these objects were actually made of pewter in England, there are several handsome examples in Bohemia, having the form of inverted bells on richly foliated tripods. Holy-water stoups were often made of pewter. There is a record of a pewter canopy over the figure of a saint in St. Vincent's church on the Garonne, in Merovingian times; and Gregory of Tours mentions a basilica roofed with pewter. The construction of organ pipes, too, consumed a large quantity of this alloy, and a record of 1481 shows that 14,500 pounds of it were used on one occasion for that purpose.

Probably the most eminent of the artistic workers in pewter was Briot, a Frenchman, who was born about the middle of the sixteenth century. He made several really fine pieces which have become historic, such as the salver representing in relief the History of Susanna and the Elders. He also made several covered tankards, an excellent specimen of which is in the British Museum, while the Louvre collection contains some superb dishes, probably for baptismal purposes, by the same master. His *chef d'œuvre*, however, is a superb ewer and dish, representing Charity and Temperance. One of his finest salvers is here illustrated.

Washington's Mess-Chest and His Camp Outfit with its Articles of Pewter Ware.

PEWTER WARE.

Howard, in his "Art Dictionary," has reproduced several lists of the pewter objects possessed by men of wealth in olden times. Thus, in 1389 the Bishop of Rheims bequeathed "18 dishes great and small, 48 porringers, a square measure, 2 square quart pitchers, 2 round *silver fashion*, 1 square pint, 2 measures of 3 chopines *silver fashion*," etc. The ewers, salvers, and flagons used by the rich and middle classes to decorate their buffets were works of art.

In France the working of pewter as an art-craft dates back to the time when Jules Bratteau and others commenced the production of the most beautiful plaques of pewter for cabinet work and bas-reliefs, as well as coffee sets, canisters, flagons, and other vessels, of original design as well as copies of the great works of the past. In Germany, also, very successful work has been done in pewter, including engraved work, and etching with the effect of "niello," which consists of cutting the design in the metal and afterward filling the incised places with a black alloy.

In the Convent of the Holy Cross at Erfwith, in Saxony, there were found, in 1470, 150 amphoræ, seventy cups, twelve jugs, three porringers, all of pewter, and at St. Cyr 200 pewter amphoræ, flagons, and tankards.

In the sixteenth century the use of pewter ware spread to the bourgeois, and it is recorded as indicative of the wide

*The photographs herewith reproduced of pewter objects in the Victoria and Albert Museum were prepared especially for this article.

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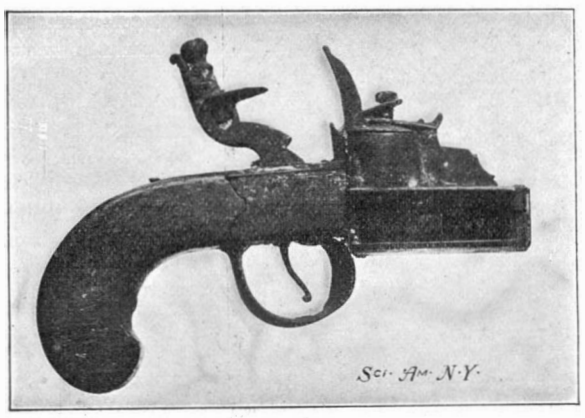
use of pewter at that date that "in France we find even a blacksmith in possession of twelve pewter plates and a tankard." The ware was fashionable too among the high ecclesiastics, as evidenced by the fact that in 1575 the Archbishop of Canterbury possessed "18 score and ten pounds of pewter vessels in the kitchen, in jugs, basins, porringers, sauce-boats, pots, and 19 candlesticks, also pewter measures in the wine



Matchlock (Snuffers) Used at Clean Drinking Manor During the Revolution.

cellar and 8 pewter salts in the pantry of Lambeth, and 2 garnishes of pewter, with spoons, at Croydon." The nobility also adopted its use extensively. Lord Northampton's kitchen as late as 1614 was furnished with 300 pounds weight of pewter, which in great houses was put under the charge of an officer called the "yeoman of the ewerie."

One of the most highly decorated of pewter objects made was a vessel called "cimaise," to hold the *vin d'honneur* (wine of honor), which was presented to kings and princes upon their royal entry into a city. The use of pewter on these occasions was probably in the interests of economy, as the vessels, whatever they might be made of, were almost invariably carried away as mementoes of the occasion.

In the British and South Kensington museums in London, in the Breslau and other European museums, as well as in some American museums and art collections, exquisite and profusely decorated specimens of pewter ware may still be seen. Examples of the ancient uses of pewter, similar to those above mentioned, could be multiplied *ad infinitum*, if necessary, to show that this ware had a distinct standing of its own not merely, or mainly, among the lower classes, but to a marked degree among princes and high officers of the Court and the Church.

The study of the history of pewter (which, as the above remarks may show, is a very interesting one) discloses the fact that in early years the skilled artisans employed in its manufacture were not only themselves anxious to produce the best possible results, but were protected and restricted by municipal or national enactments to aid them in this direction. Moreover, they served to prevent fraud in the composition of the alloy and to check the execution of inferior or slovenly work. Thus, in England, as early as 1348, ordinances were granted by the Mayor of London, permitting the use of only two qualities of pewter; the first, called "*finite* pewter," contained as much brass as the tin "of its own nature will take." Of this quality were made *esquelles* or porringers, salt-cellars, platters, pitchers, cruets, and other things that were made squared or ribbed. The second quality consisted of tin with about twenty per cent of lead, and this was used for pewter plate. Occasionally other metals than lead were mixed with tin to produce pewter, such as zinc, bismuth, copper, and antimony.

No pewter goods could be brought into the City of London until they had been assayed. In 1430 the exact weight of all the principal vessels of pewter was fixed, to prevent light weight being sold. In 1503 an act of Parliament was passed prohibiting the sale of pewter off the premises of a pewterer, except in open market, and every piece had to bear the maker's mark.

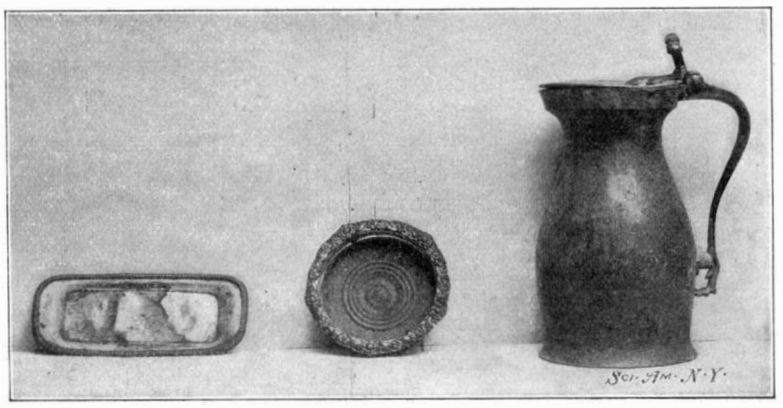
Wardens were appointed to search for defective ware five times a year. In the reign of Henry VIII. statutes were enacted forbidding the importation of pewter, and no foreigner was allowed to practise the trade in England, nor were English pewterers allowed to exercise their calling abroad under pain of alienation. Under later sovereigns each maker of pewter was obliged to deliver to the "master" a private mark, which was impressed on a plate kept in the hall of the pewterers' company, and with this all his wares were to be

A Colonial Pewter Teapot.

stamped. A fine of one penny a pound was levied on all defective and unmarked pewter. A quaint enactment forbade all pewterers to boast of their goods and disparage those of others, or to entice away the customers of other pewterers. (In passing it may be remarked that such a law now-a-days might considerably injure the advertising business.)

By an ordinance of 1575 every one aspiring to be a master pewterer was obliged to make within the space of a week "a quart ewer on a foot, a dish about four pounds in weight, and a pitcher holding four or five pots, bearing a written snatch or proverb."

Pewter Pitcher and Pot Used by Samuel Chase, a Signer of the Declaration of Independence and Justice of the Supreme Court.

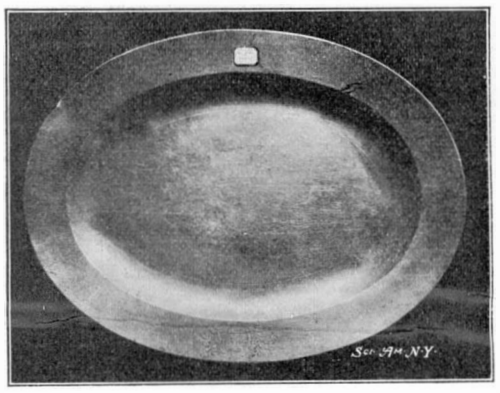


A Pewter Tray, an English Decanter Slide and a Pewter Tankard Used at Clean Drinking Manor, Md., During the Revolution.

A Miscellaneous Collection in Which Are Included Some Pewter Articles Belonging to Washington.

Silversmiths were prohibited from working in pewter and *vice versa*, and until 1650 it was unlawful to plate with gold or silver any objects made from the baser metals; and even after that date pewter objects covered with silver or gilding had to be specially marked, to prevent their being placed on the market as specimens of the precious metals.

In Rouen a "pewterers' guild" was established, and royal letters were given, fixing the exchange value



A Colonial Pewter Platter.

of new for old metal, and decreeing against improper or fraudulent alloys. So stringent were the laws in aiming at the best results that pewterers were forbidden to work at night, for fear that artificial light might prevent first-class productions. Fines were imposed for unauthorized alloys, and leaden imitations were also punishable.

The manufacture of pewter goods was, as already shown, most extensively carried on in England, France, Germany, and Switzerland during the fourteenth, fifteenth, and sixteenth centuries, and even as early as the time of the Plantagenets pewter chalices were used in English churches.

In Japan pewter objects were made in the eighth century, and the first record of the industry in that country was during the reign of the Empress Shotoku, when pewter vases and various other utensils were manufactured from native tin.

In China the use of pewter was probably still more ancient, but there is no definite record of the date of its introduction.

From England the pewter industry spread to America at the time when wooden ware was in common use, and this it displaced. Quite a number of handsome pieces of pewter ware are still to be found in New England country homes, and the number would doubtless be much larger, had it not been discovered that new pewter is much improved if the metals comprising it are mixed with a certain amount of old pewter. "Hence," writes Mrs. Alice Morse Earle, "old pewter has always commanded a good price, and many fine old specimens have been melted up to mold over again for the more modern uses for which pewter is employed by printers and lapidaries."

Many of the English pewterers came over to the American colonies in the seventeenth century. Among them was Richard Graves, a pewterer of Salem, and Henry Shrimpton, who became an influential merchant of Boston. These and others made pewter ware for the Massachusetts colonists. Their number increased until the war of independence, at which time the increasing importation of Oriental and English china and stoneware destroyed the pewterers' trade.

"At the time this industry was at its height in New England," continues Mrs. Earle, "pewter cans for beer, cider, and metheglin were found in almost every house; also pewter mugs, dram-cups with funnels; basins, cisterns, and ewers graced the parlors, which latter also contained the best bed for the use of guests. Pewter candlesticks held the home-made pale-green candles of tallow and spicy bayberry wax. 'Savealls' too, were of pewter and iron. These were little round frames with wire points, to hold up the short ends of candles. Salt cellars and spoons also were made of pewter, and pewter porringers or 'pottingers' of every size were much coveted. Plates and platters of pewter were also highly prized."

It is recorded that Governor Bradford of Massachusetts left to his heirs fourteen pewter dishes and thirteen platters, three large and three small plates, one pewter candlestick

PEWTER WARE.

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and one pewter bottle. This was considered a very luxurious household outfit. Governor Benedict Arnold, of Rhode Island, and Mr. Pyncheon, of Springfield, Mass., bequeathed their pewter plates and dishes, and the humble pewter was just as elaborately lettered and marked with armorial devices as the silver objects.

Pewter was also used in New England for communion services. In 1729 the First Church of Hanover, Mass., bought, and used for years, a full communion service and christening basin of pewter. Some of the pieces are still preserved by the church as relics, while the tankards have been silver-plated and are still in use. As late as the dawn of the nineteenth century advertisements of "pewter communion flagons" appeared in New England newspapers. Pewter dishes and plates were a source of great pride to every colonial housekeeper, and much time and labor were devoted to polishing them with "horsetails" (*Equisetum*) or "scouring rush," till they shone like fine silver, and dingy pewter was regarded as a disgrace.

In some old homes the pewter utensils have been preserved, and are even now cherished ornaments of the kitchen and dining room. Thus, in an old homestead in Shrewsbury, Mass., its greatest treasures are cupboards and dressers full of pewter dishes. All the plates and platters are round, for oval platters seem to have been then unknown.

Another pewter piece, still in use in some localities, is the hot-water jug with a wicker-covered handle. This, we read, was filled at night with boiling water and brought to the master of the house, for him to mix the apple toddy or sangaree for his household people, who drank out of pewter cups or heavy greenish glasses. Mrs. Earle, who has written very interestingly on the subject, and from whose writings some of the above statements have been derived, mentions two of these jugs which have been in daily use for certainly forty years, for carrying hot water to bedrooms for shaving purposes, and they still retain the old wicker coverings on the handles, woven perhaps a hundred years ago. "These old pewter dishes, etc.," she continues, "have strange hiding-places. They lurk in tall and narrow cupboards by the side of old chimneys, or in short and deep cupboards over the mantel. They lie in disused fireplaces, or in deep boxes under wide window-seats, and under the dusty eaves of dark attic lofts; or on the highest pantry shelves, under cellar stairs, and in old painted sea-chests they have found a home."

The illustrations used in this article, with the exception of a few to which attention has been called in a foot note, are from photographs of historical pewter ware in the National Museum at Washington. As will be seen from the legends which accompany them, they represent a variety of objects used by persons of eminence in Colonial and later times.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

CIRCUIT-BREAKER FOR STORAGE BATTERIES.—H. GARRETT, Dallas, Texas. Mr. Garrett's invention relates to an improved circuit-breaker for storage batteries, and more particularly to an appliance for breaking the main circuit of the battery when the voltage reaches a predetermined minimum limit. When properly adjusted at the proper voltage, there will be absolutely no spark at all.

Engineering Improvements.

ROTARY VALVE.—D. W. RANTINE, New York, N. Y. The object in this invention is to provide a rotary valve which is very effective in operation, and arranged to accurately control the admission and exhaust of the motive agent, and thereby insure an easy running of the engine and utilization of the motive agent to the fullest advantage.

VALVE MECHANISM FOR ENGINES.—H. NIELSEN, New York, N. Y. In this case the purpose is to provide an engine arranged to insure a positive shifting of the engine-valve directly from the piston reciprocating in the cylinder, thus dispensing with complicated valve-gear, the arrangement being such that waste and leakage of the motive agent are reduced to a minimum, and the agent is utilized to the fullest advantage, so as to render the engine particularly well adapted for use as a pumping-engine.

ROTARY ENGINE.—C. GUYER, Muncy, Pa. This engine is arranged to utilize the motive agent very economically and expansively to the fullest advantage. Steam is cut off during a desired portion of the stroke of the piston, to allow it to work expansively. As the steam-pressure is equal on the ring and the disk, the piston is completely balanced, and hence the engine runs easily without undue loss of power and without waste of steam.

PROPELLER.—E. BRÜNCKER, Cologne, Germany. The object here is to provide a propeller arranged to insure an effective forward as well as backward action by causing the propeller-blades to readily cut with the forward edges into the water, to allow the water to readily pass from the blades at their rear edges without danger of forming dead-water spaces, at the same time preventing undue resistance and concentrating the active force at the middle portion of the blade, to increase the propelling effect of the propeller when driven forward or backward, and to reduce slip to a minimum.

Heating and Lighting.

FEED-WATER HEATER AND PURIFIER.—T. V. ELLIOTT, Columbia, Pa. This invention is an improvement in feed water heaters for use in connection with steam-boiler furnaces. The water supplied to the feed-water heater is raised to a comparatively high temperature before being discharged into the boiler, and by reason of the upward circulation of the water in the manifolds the water will be purified within the feed-water heater before being delivered into the boiler.

FURNACE.—T. V. ELLIOTT, Brooklyn, N. Y. In this instance the improvement is in furnaces, particularly smoke and gas consuming furnaces, and especially in that class in which oil, air, and steam are utilized in securing a consumption of the gases and other products of combustion; and the invention relates to means for securing the return of the gases and smoke and a disposition thereof within the furnace.

BOILER-FURNACE.—E. F. COMBER, Selkirk, Canada. One object the inventor has in view is the provision of a bridge-wall by which warm air in regulated volumes may be supplied to the combustion-chamber of a furnace at a point back of the fuel-grate, the air being free to commingle with the gaseous products of combustion and calculated to promote the combustion of the gases and of carbon in the smoke. Besides with steam boilers, the improvements may be used in hot-water boilers and in connection with any kind of furnaces for power and heating purposes.

Miscellaneous.

SHOE-LACING.—J. MCMAHON, Bemidji, Minn. The purpose in this invention is to provide an anchorage device for one end of the lace secured at the lower portion of the front opening for the upper of the shoe adjacent to the vamp and a series of pulley devices which are secured to the upper quarters at opposite sides of the front opening which devices are guides for the lace and are in alternate arrangement, and to provide the upper quarter of the shoe at opposite sides of the upper portion of its front opening with guide hooks.

PHOTOGRAPHIC CAMERA.—H. W. HALES, Ridgewood, N. J. The object of the improvement is the provision of a camera arranged to produce an exceedingly sharp and brilliant image on the focusing medium and subsequently on the sensitive plate or film in such a manner that the operator while focusing can view the image right side up or non-inverted.

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Inquiry No. 4922.—For makers of money alarm drawers.

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Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(9256) H. W. H. writes: What per cent of power per horse power of heat is lost in the water used by a gas engine? A. It is impossible for us to give you any definite answer to the question. We would say, however, that in a general way it is true that a gas engine utilizes, as a rule, less than 25 per cent of the heat generated, and about half of the loss is usually carried off by the jacket water.

(9257) O. C. S. says: Can a man working but a short time do twice as much work when turning two cranks, such as are used in a boring machine much used by carpenters, as he can when turning but one crank and standing in the most favorable position? If not, why not? How much can he do compared with a man turning a single crank? When working all day can a man do any more turning two cranks than he can when turning one crank? Please give figures showing the relative amount of work done. A. In reply to your inquiry regarding the amount of work that a man can do when turning two cranks, such as are used in a boring machine, as compared with the amount that he could do turning but one crank, we would say that there is no definite data on this subject. The amount of work that a man can do in a given length of time is greatest when the motions required of him are the most natural and most favorable to the strength of his muscles. Thus, as work is a product of *force* times *distance*, a man is able to do but very little work when the force required is so great that he can overcome it through only a short distance in a given amount of time. On the other hand, he will accomplish little work if the force is very small, and he is required to work too rapidly. Between these limits there is a relation of *force* to *speed* in which he can do the maximum work. A man can accomplish no more turning two cranks than he can accomplish turning one crank, provided the one crank is so arranged that he can work favorably with both arms upon it, and exert a force which will give the most favorable relation between force and speed to produce the maximum work. Practically, it is found that the two cranks set at 180 degrees in a boring machine, similar to the pedals of a bicycle, give a condition which is exceedingly favorable for the average man to do his maximum work.

(9258) H. A. P. says: Will you kindly answer the following questions? I have two coils of 1-inch pipe. One is 11 inches and the other is 5 inches in diameter inside measure; both have seven and a half turns. The small coil fits inside the large coil and is coupled at top and bottom. The flow must heat to 80 deg. beneath a "hover" 72 feet by 24 inches by 6 inches, returning through the "run," 72 feet by 3 feet by 3 feet, heating to about 60 deg. Would a double or triple line of pipe be suggested, and what size (pipe)? Will I place the expansion tank on the flow, or return, close to heater or otherwise? The pipe will be on a level. A. You have not given us information enough in your inquiry to make it possible for us to answer your questions. Without knowing exactly the heat to which your coils are subjected, we cannot tell you the rate of circulation or the amount of heating surface needed to raise the water to any given temperature.

NEW BOOKS, ETC.

THE NEW INTERNATIONAL ENCYCLOPEDIA. Volume X. Infantry to Larramendi. Edited by Profs. Daniel Coit Gilman, LL.D.; Harry Thurston Peck, Ph.D., L.D.H.; Franklin Moore Colby, M.A. New York: Dodd, Mead & Co. 1903. 8vo. Pp. 986.

In taking up the tenth volume of this truly important work, we are more than ever convinced of the great merit which this encyclopedia possesses. Its treatment of all subjects is most admirable, and the scientific articles and definitions are both concise and reliable. The illustrative features add greatly to the interest of the volume. The inclusion of the lives of living persons is especially to be commended. The maps are fine examples of the cartographer's art. Technical matters are far from being neglected; thus, under "Ink" we find a very common-sense discussion of black ink, red ink, blue ink, aniline inks, metallic inks, special inks, sympathetic inks, ink powders, and printing inks, together with several bibliographical references of considerable value. The good points of the general scheme of the encyclopedia are emphasized by the sustained work which characterizes each successive volume.

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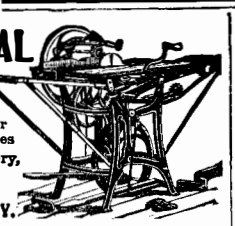

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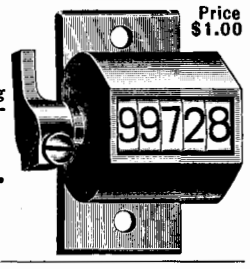

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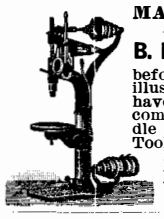

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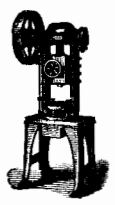

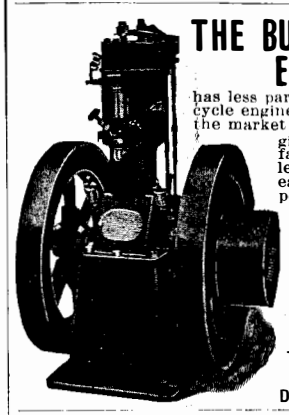

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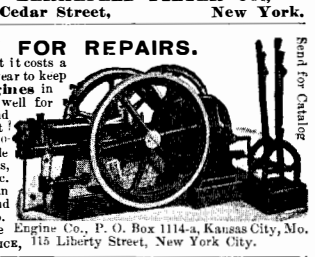

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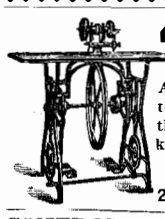

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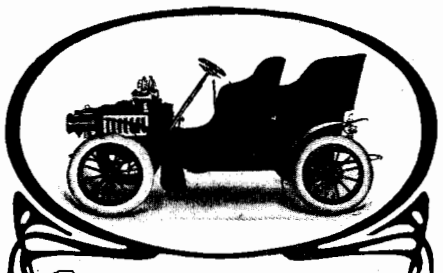

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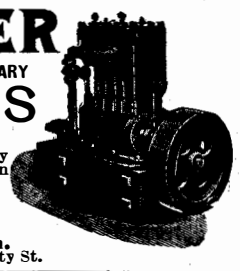

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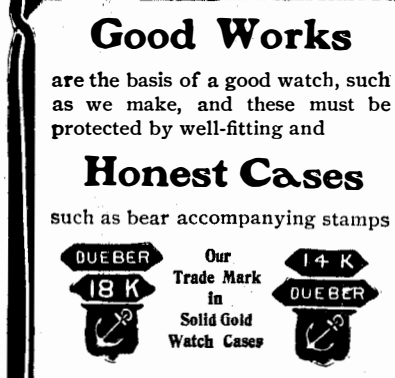

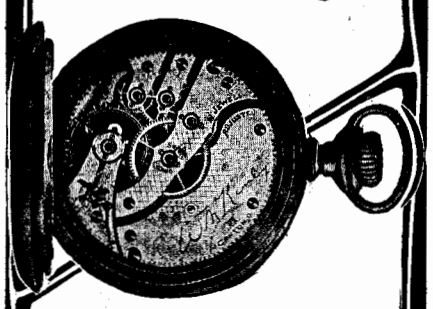

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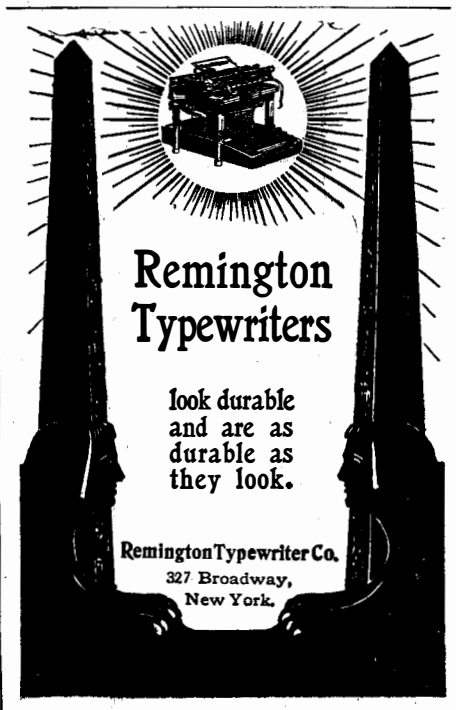

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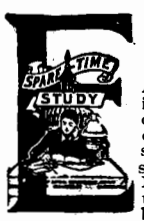

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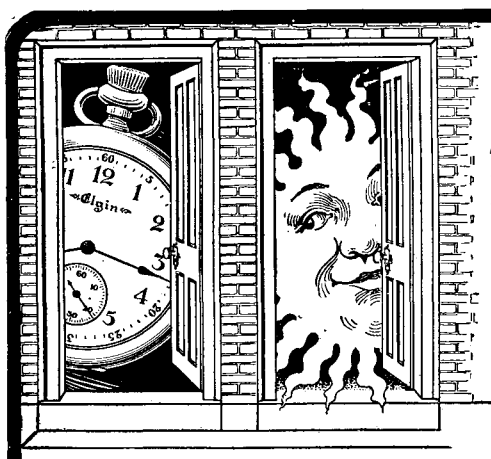

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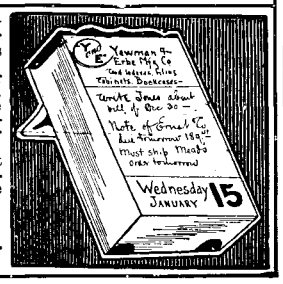

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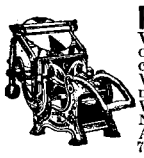

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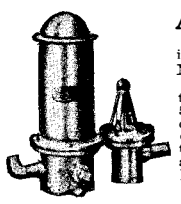

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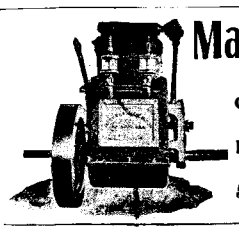

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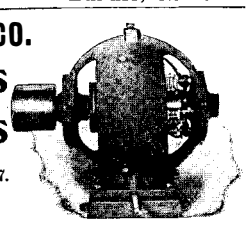

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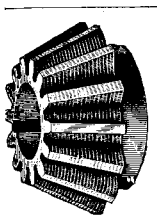

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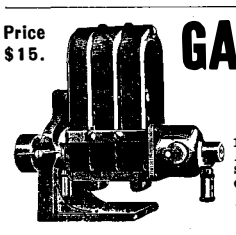

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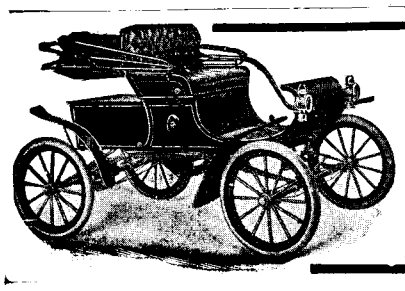

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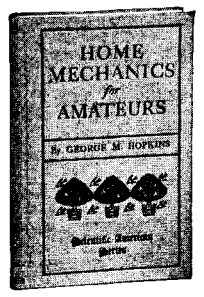

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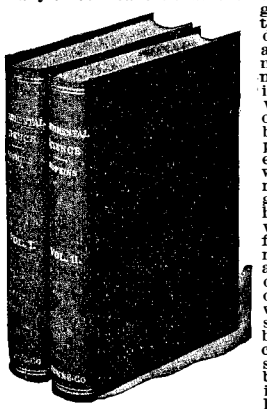

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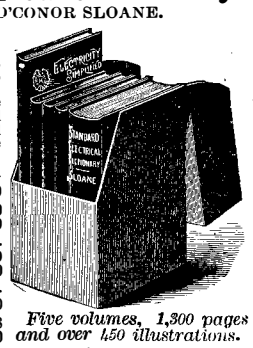

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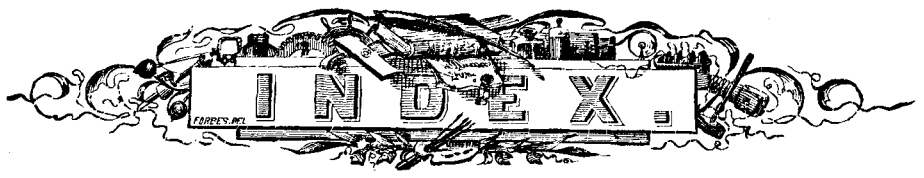

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